

101-11:5-3805-250-14

This copy is a reprint which includes current  
pages from Changes 1 and 5.

**TM 5-3805-250-14**

RETURN TO 5-3805-250-14

**TECHNICAL MANUAL**  
**OPERATOR, ORGANIZATIONAL,**  
**DIRECT SUPPORT AND GENERAL SUPPORT**  
**MAINTENANCE MANUAL**  
**LOADER, SCOOP TYPE DED,**  
**4 WHEEL DRIVE, PNEUMATIC TIRED,**  
**HINGED FRAME STEER, 2 1/2 CU. YD.**  
**MULTI-PURPOSE BUCKET,**  
**(J.I. CASE MODEL MW-24)**  
**FSN 3805-253-0627**

**HEADQUARTERS, DEPARTMENT OF THE ARMY**

**DECEMBER 1970**

## **SAFETY PRECAUTIONS**

### **BEFORE OPERATION**

Keep equipment free of oil, grease and dirt to ensure proper control.

Do not smoke or use an open flame when charging the batteries. Batteries generate hydrogen, a highly explosive gas.

Check loader before starting. Make sure area is clear of personnel before moving loader. Sound horn before moving loader.

Never move loader if low air pressure buzzer is sounding. Wait until air pressure gage indicates between 75 and 125 psi.

Remove cold weather starting aid cylinder when the loader is to be operated in warm climates to prevent inadvertent injection of fluid into the engine.

Do not crank engine more than 30 seconds continuously without allowing a 2 minute cooling off period.

### **DURING OPERATION**

Do not operate loader indoors unless the area is well ventilated.

Report or correct any condition that may result in injury to personnel or damage to the machine if operation is continued.

Operate machine at speeds consistent with conditions of the particular job.

Do not use the bucket as a brake.

Never get on or off loader while it is moving. Do not permit anyone to ride on the outside of the loader.

Do not down shift from high range to low range at speeds in excess of 5 mph.

### **AFTER OPERATION**

Always lower the bucket to the ground when loader is not in use. Place all levers in neutral position.

Set the parking brake when parking loader. Block the wheels when parking on an incline.

Report or correct any condition that may result in injury to personnel or damage to the machine.

Stop machine and shut off engine before lubricating, adjusting or servicing.

Disconnect the battery ground cable before servicing any electrical system component.

Exercise caution when removing the radiator cap while engine is hot. Quick removal may allow hot coolant to escape and seriously injure personnel.

### **EMERGENCY TOWING**

This loader is not designed as a tow vehicle. If used as such, hydraulic oil may become extremely overheated, possibly damaging hydraulic components and hoses.

If the loader must be used as a tow vehicle for any sustained period, move the loader hydraulic controls periodically. This will circulate oil throughout the hydraulic system and reduce the possibility of overheating.



CHANGE }  
No. 1 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D. C., 5 January 1972

**Operator, Organizational, Direct Support and General Support  
Maintenance Manual**

**LOADER, SCOOP TYPE DED, 4-WHEEL DRIVE, PNEUMATIC TIRED,  
HINGED FRAME STEER, 2 1/2 CU. YD. MULTI-PURPOSE BUCKET**

**(J. I. CASE MODEL MW-24)**

**FSN 3805-253-0627**

TM 5-3805-250-14, 2 December 1970, is changed as follows:

*Page i*, add page number i to first page of the table of contents.  
Section XIX of Chapter 4 change page number "4-34" to read "4-33."

*Page ii*, Chapter 5, Section IV delete "and auxiliaries."

Chapter 6, Section V add "6-18" in paragraph column and "6-31" in page column.

*Page iii*, between figure 4-15 and 4-16 add: "4-15.1 Water pump, removal and installation."

*Page iv*, line 59, delete figure 6-30 entirely.

*Page v*, figures 6-56 and 7-1 add:

"6-57 Compression adapter"

"6-58 Compression gauge"

"6-59 Fuel injector"

In the page column of figure 7-9 change the page number "7-9" to read "7-14."

In the page column of fig. 7-38 change page number "7-72" to read "7-52."

*Page vi*, line 16 add "(two sheets)" in title column and change page column from "8-27" to "8-26, 8-27."

Delete figure 8-25 entirely.

*Page 1-2*, (para. 1-7a,) line 1 change "sight" to read "seven."

*Page 1-3*, in sub-paragraph (2) of b. Tabulated Data line 14, change the data column from "17 quarts" to "17 quarts, 19 quarts w/filter."

In sub-paragraph 6 change title "(6) Fuel Pump" to read "(6) Fuel Injection Pump."

*Page 1-5*, paragraph 1-7b, subparagraph (29), line 4, change data column "Instrument panel" to read "Instrument panel (LM)."

Subparagraph (32), change data column "22 to 28 1/2 volts" to read "22 to 28 1/2 volts (Green Zone)."

Subparagraph (33), line 5, change data column "Instrument panel (LH)" to read "Instrument panel (RH)."

Subparagraph (34), change title "(34) Torque converter pressure gage" to read "(34) Clutch Pressure Gage."

Subparagraph (35), line 6, change data column "Instrument panel" to read "Instrument panel (RH)."

Subparagraph (36), change title "(36) Fuel tank" to read "(37) Fuel tank." and add subparagraph following subparagraph (35) as follows:

**(36) Fuel Pressure Gage**

Make \_\_\_\_\_ Stewart Warner  
Model \_\_\_\_\_ 352 HT  
Range \_\_\_\_\_ 0-100 PSI

*Normal Operating*

Pressure \_\_\_\_\_ 25 PSI  
Location \_\_\_\_\_ Hood

Subparagraph "(37) Physical and functional dimensions" is changed to read "(38) Physical and functional dimensions."

Subparagraph "(38) Torque data" is changed to read "(39) Torque data."

Change torque specifications "pound-feet" to read "foot-pounds".

Line 8, change data column "65 to 70 pounds-foot" to read "65 to 70 inch-pounds".

Add to the end of subparagraph (38)

Drive flange \_\_\_\_\_ 600-700 foot-pounds  
U-Joint spider bolts \_\_\_\_\_ 30-40 foot-pounds  
Planetary cover bolts \_\_\_\_\_ 50-55 foot-pounds  
Wheel mountings \_\_\_\_\_ 365-400 foot-pounds  
Alternator brush cover  
screw \_\_\_\_\_ 20-30 inch-pounds  
Alternator brush assembly  
mounting screws \_\_\_\_\_ 16-20 inch-pounds

### WARNING

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

### WARNING

Drycleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F. — 138° F.

## Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

### 3-4. Maintenance Forms and Records

Every mission begins and ends with the paperwork. There isn't much of it, but you have to keep it up. The forms and records you fill out have several uses. They are a permanent record of the services, repairs, and modifications made on your equipment; they are reports to organizational maintenance and to your commander; and they are a checklist for you when you want to know what is wrong with the equipment after its last use, and whether those faults have been fixed. For the information you need on forms and records, see TM 38-750.

### 3-5. Preventive Maintenance Checks and Services

a. Do your (B) PREVENTIVE MAINTENANCE just before you operate the scoop loader. Pay attention to the CAUTIONS and WARNINGS.

b. Do your (D) PREVENTIVE MAINTENANCE during operation. (During operation means to monitor the scoop loader and its related components/systems, such as the brakes, while they are actually being operated).

c. Do your (A) PREVENTIVE MAINTENANCE right after operating the scoop loader. Pay attention to the CAUTIONS and WARNINGS.

d. Do your (W) PREVENTIVE MAINTENANCE weekly.

e. Do your (M) PREVENTIVE MAINTENANCE once a month.

f. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.

g. Always do your preventive maintenance in the same order, so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

h. If anything looks wrong and you can't fix it, write it on your DA Form 2404 (Equipment Inspection and Maintenance Worksheet). If you find something seriously wrong, report it to

organizational maintenance RIGHT NOW.

i. When you do your preventive maintenance, take along the tools you need to make all the checks. You always need a rag or two.

### WARNING

Drycleaning solvent, used to clean parts, is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 138° F.

(1) *Keep it clean.* Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use drycleaning solvent (SD-2) to clean metal surfaces. Use soap and water when you clean rubber or plastic material.

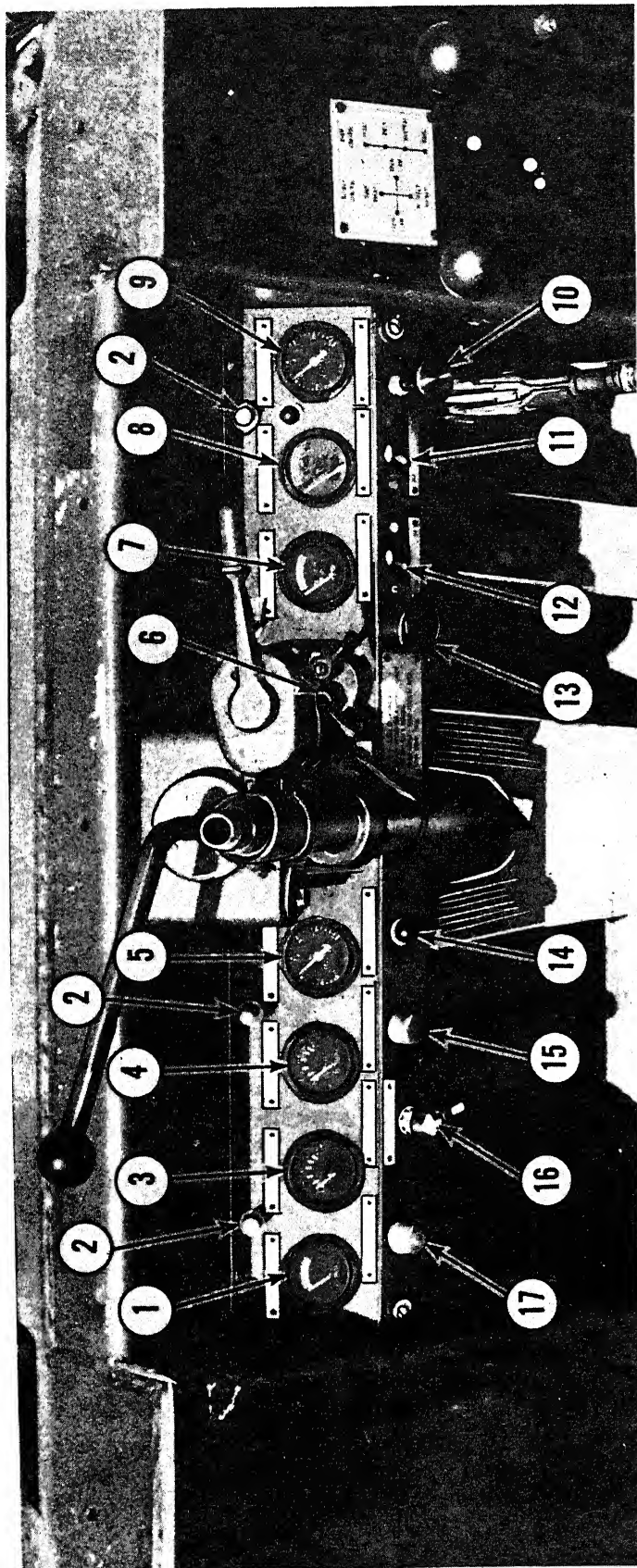
(2) *Bolts, nuts, and screws.* Check that they are not loose, missing, bent, or broken. You can't try them all with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. If you find one loose, tighten it or report it to organizational maintenance.

(3) *Welds.* Look for those loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to organizational maintenance.

(4) *Electric wires and connectors.* Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connectors and make sure the wires are in good condition.

(5) *Hoses and fluid lines.* Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, of course, but a stain around a fitting or connector can also mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to organizational maintenance.

j. It is necessary for you to know how fluid leakage affects the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and REMEMBER — When in doubt, notify your supervisor!



1. VOLTMETER. INDICATES THE CONDITION OF THE BATTERIES. NORMAL READING IS IN THE GREEN ZONE. THE NEEDLE FLUCTUATES SLIGHTLY WITH DRAIN ON THE ELECTRICAL SYSTEM AND WITH BATTERY CONDITION.
2. PANEL LIGHTS. FOUR LIGHTS ILLUMINATE THE INSTRUMENT PANEL. SEE THE MASTER LIGHT SWITCH (FIG. 2-3) FOR OPERATION.
3. OIL PRESSURE GAGE. INDICATES THE ENGINE LUBRICATION SYSTEM OIL PRESSURE. NORMAL OPERATING PRESSURE IS 45 TO 55 PSI.
4. ENGINE TEMPERATURE GAGE. INDICATES THE ENGINE COOLANT TEMPERATURE. NORMAL OPERATING TEMPERATURE IS 179° F TO 210° F.
5. HYDRAULIC OIL PUMP INLET GAGE. INDICATES PRESSURE OF HYDRAULIC OIL AS IT ENTERS THE HYDRAULIC PUMP. NORMAL OPERATING PRESSURE IS 12 TO 14 PSI. IDLING PRESSURE IS 13 TO 19 PSI. REFER TO FIGURE 2-3 FOR DETAILS AND OPERATION.
6. MASTER LIGHT SWITCH. INDICATES THE TORQUE CONVERTER TEMPERATURE GAGE. INDICATES THE TORQUE CONVERTER OIL TEMPERATURE. NORMAL GAGE READING IS IN THE GREEN ZONE (250° TO 360° F).
8. CLUTCH PRESSURE GAGE. INDICATES THE HYDRAULIC CLUTCH OIL PRESSURE. NORMAL OPERATING PRESSURE IS 145 TO 180

9. AIR PRESSURE GAGE. INDICATES THE AIR PRESSURE IN THE BRAKE SYSTEM. NORMAL OPERATING PRESSURE IS 105 TO 125 PSI.
10. FUEL SHUTOFF CONTROL. A PUSH-PULL TYPE CABLE THAT STOPS THE FLOW OF FUEL TO THE INJECTION PUMP BEFORE THE ENGINE IS SHUT DOWN.
11. FLOODLIGHT SWITCH. AN ON-OFF TYPE SWITCH THAT ACTUATES THE FLOODLIGHTS.
12. AUXILIARY FLOODLIGHT SWITCH. AN ON-OFF TYPE SWITCH THAT ACTUATES THE AUXILIARY FLOODLIGHT.
13. COLD STARTING AID SWITCH. A PUSH BUTTON SWITCH THAT ACTIVATES THE COLD START CYLINDER.
14. IGNITION INDICATOR LIGHT. A LIGHT WHICH ILLUMINATES TO INDICATE POSITIVE ELECTRICAL CURRENT IN THE SYSTEM.
15. START BUTTON. A PUSH BUTTON SWITCH THAT ACTIVATES THE STARTING MOTOR.
16. MASTER SWITCH. A TOGGLE SWITCH THAT ACTIVATES THE LOADER ELECTRICAL SYSTEM.
17. HORN BUTTON. A PUSH BUTTON SWITCH THAT ACTIVATES THE HORN.

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Figure 2-2. Instrument panel.

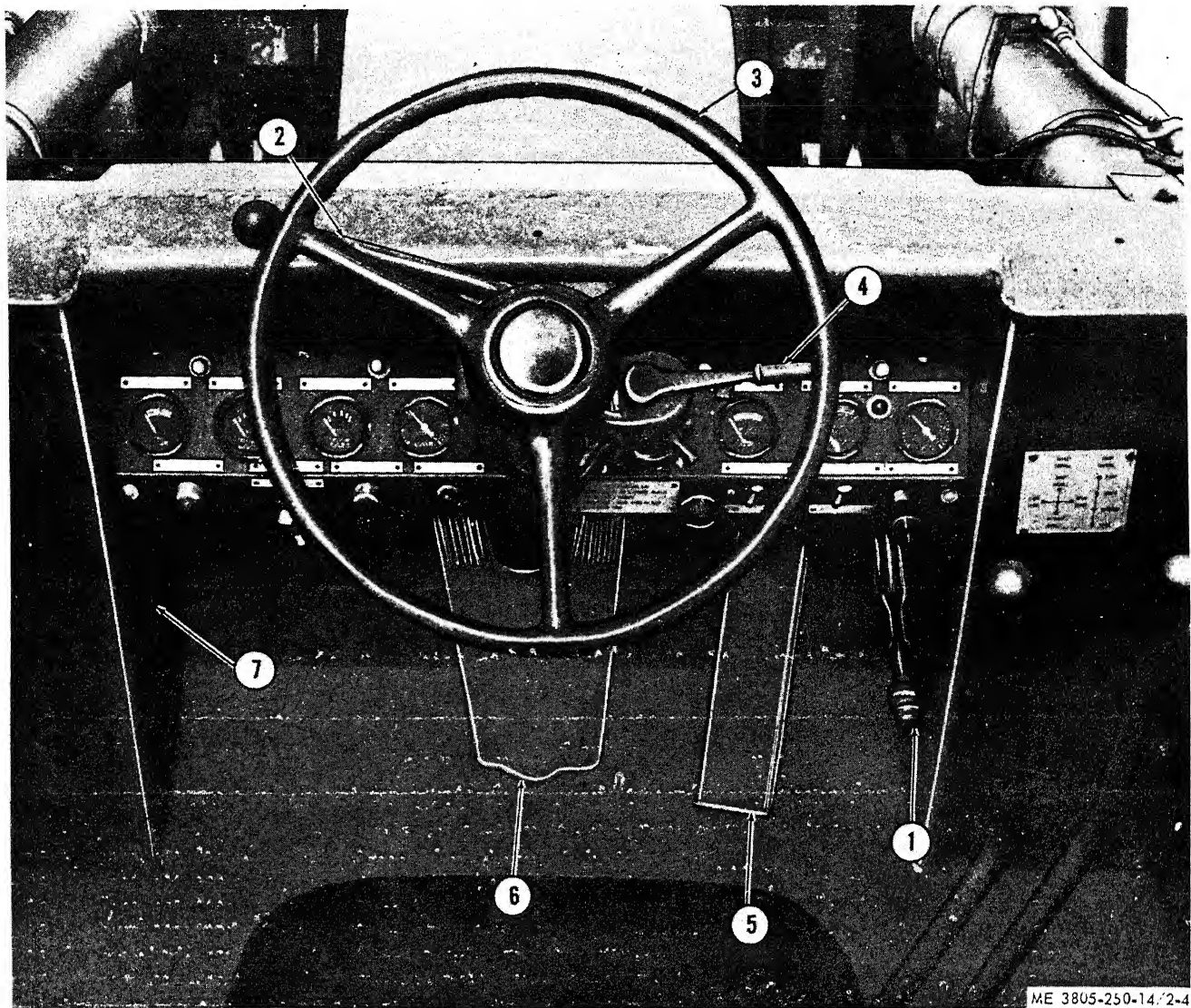


Figure 2-4. Operators compartment controls.

Page 4-2 change title. "Table 4-1. Monthly Preventive Maintenance Checks and Services" to read "Table 4-2. Monthly Preventive Maintenance Checks and Services."

Delete item 7 in its entirety and renumber succeeding items.

Table 4-1. Special Tools

Item	FSN	Reference Para. No.	Use
Wrench, Metric size, 10 MM	5120-177-7325	4-16, 4-18	For adjustment of the fuel shut-off valve and fuel transfer pump removal.

Item 15, in the procedure column is changed to read "Inspect for leaks and damage. Check mounting capscrew torque for 20 foot-pounds."

"Table 4-2. Troubleshooting" is changed to read "Table 4-3. Troubleshooting."

Page 4-4, paragraph 4-13d is changed to read, "d. Remove the filter element (fig. 4-1) by unscrewing case bolt and removing the case with the filter.



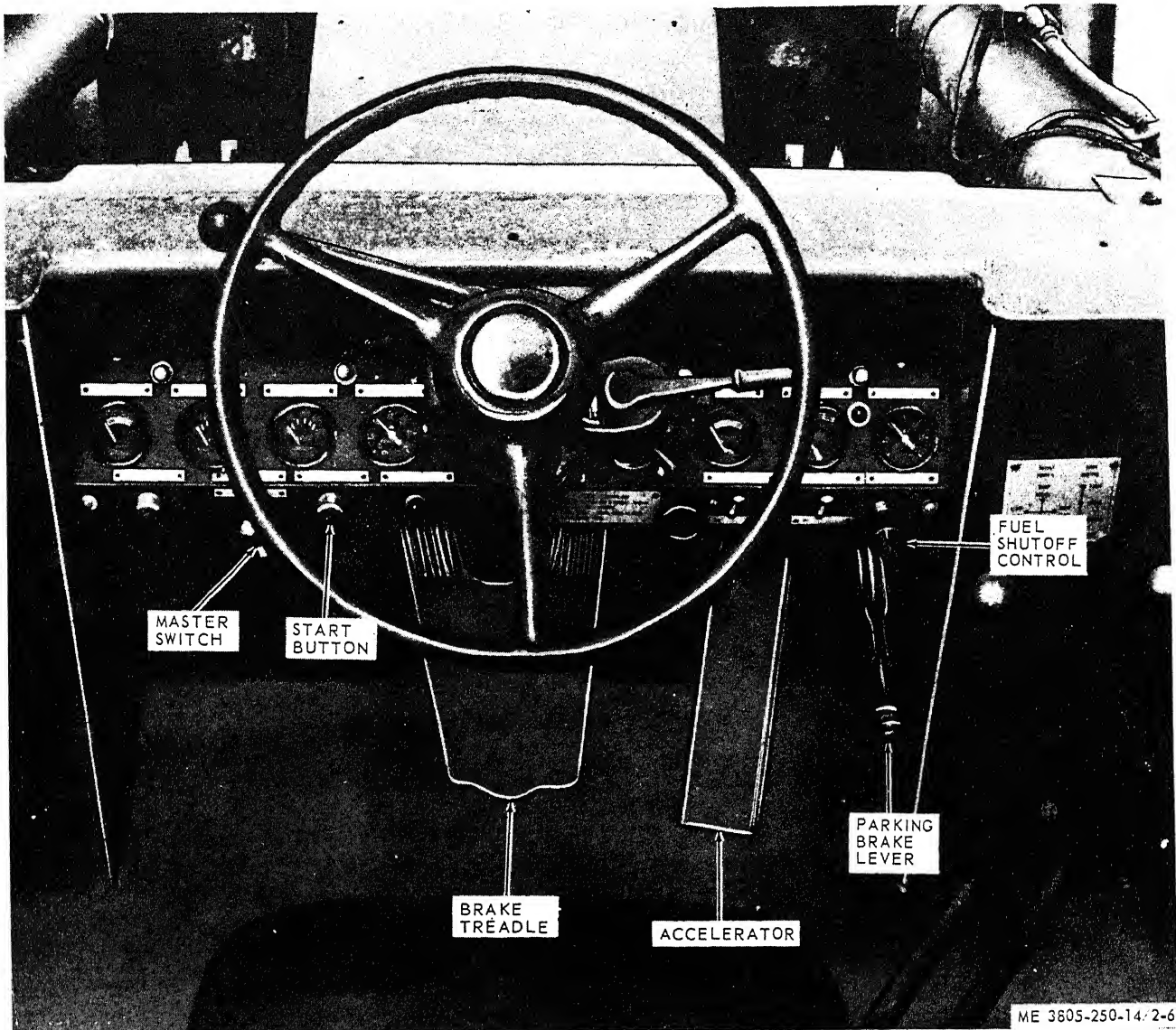


Figure 2-6. Loader starting and stopping procedures.

Paragraph 4-13f is changed to read, "f. Install a new filter element in the filter case and a new case gasket. Install the case."

Page 4-5, paragraph 4-14a(1) is changed to read "Remove the left side engine panel and the left side of the hood".

Page 4-12, paragraph 4-25, b is deleted.

Paragraph 4-26.1 is added after paragraph 4-26 as follows:

#### "4-26.1 Fan Assembly.

##### a. Removal.

(1) Drain the cooling system and remove the left fan guard (fig. 4-13).

(2) Remove four mounting bolts and lock-washers, and remove the fan from the water pump.

##### b. Cleaning, Inspection and Repair.

(1) Clean the fan with solvent.

(2) Inspect the fan blades for bends or dents. Straighten any blades that are out of line.

(3) Check the fan blades to ensure they are held securely in position.

##### c. Installation.

(1) Install the fan by reversing the removal procedure.

(2) Install the left fan guard (fig. 4-13) and service the cooling system (para. 2-1).

Page 4-14, paragraph 4-28, after subparagraph a add note, "If the engine overheats or does not reach and maintain a minimum temperature of 180 degrees, replace the thermostat."

Delete paragraph c(1) through (4) entirely and renumber paragraphs "d, e, and f" to read, "c, d, and e".

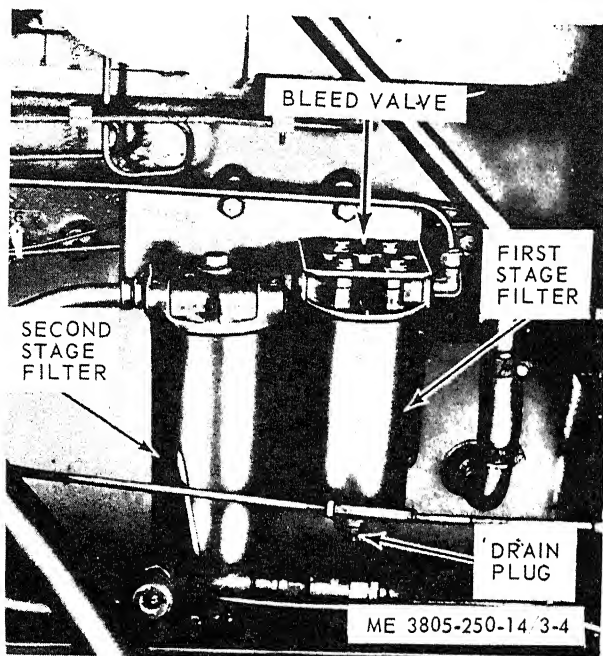


Figure 3-4. Fuel filter service.

Figure 4-15.1 is added as follows:

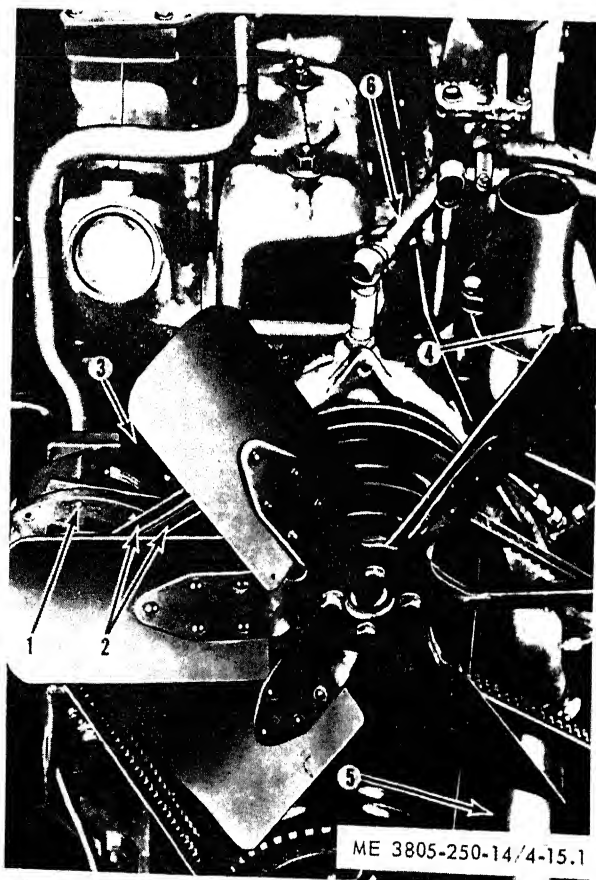


Figure 4-15.1. Water pump, removal and installation.

Add paragraph 4-29.1 after (para. 4-29) as follows:

#### "4-29.1 Water Pump

##### a. Removal

(1) Drain the cooling system and remove the left fan guard (fig. 4-13)."

(2) Loosen the alternator adjusting strap bolt (1, fig. 4-15.1) and remove the fan belt (2).

(3) Remove four bolts and lockwashers securing the fan to the pulley, and remove the fan.

(4) Disconnect the oil cooler line (3) and discard the gasket.

(5) Disconnect the clamp securing the bypass hose (4) to the water pump housing.

(6) Disconnect the clamp securing the lower radiator hose (5) to the housing.

(7) Disconnect the air compressor line (6).

(8) Remove four bolts and lockwashers, and one washer and spacer securing the pump housing to the block. Remove the pump and discard the mounting gasket.

##### b. Installation.

(1) Install the water pump housing and new gasket to the block. Tighten the mounting bolts evenly to 25 to 42 foot-pounds.

(2) Install the lower radiator hose (5) and secure with clamp.

(3) Connect the air compressor line (6).

(4) Connect the oil cooler line (3) and install a new gasket. Tighten bolts to a torque of 17 to 20 foot pounds.

(5) Install the by-pass hose (4) and secure with a clamp.

(6) Install the fan belts and adjust as described in paragraph 4-27.

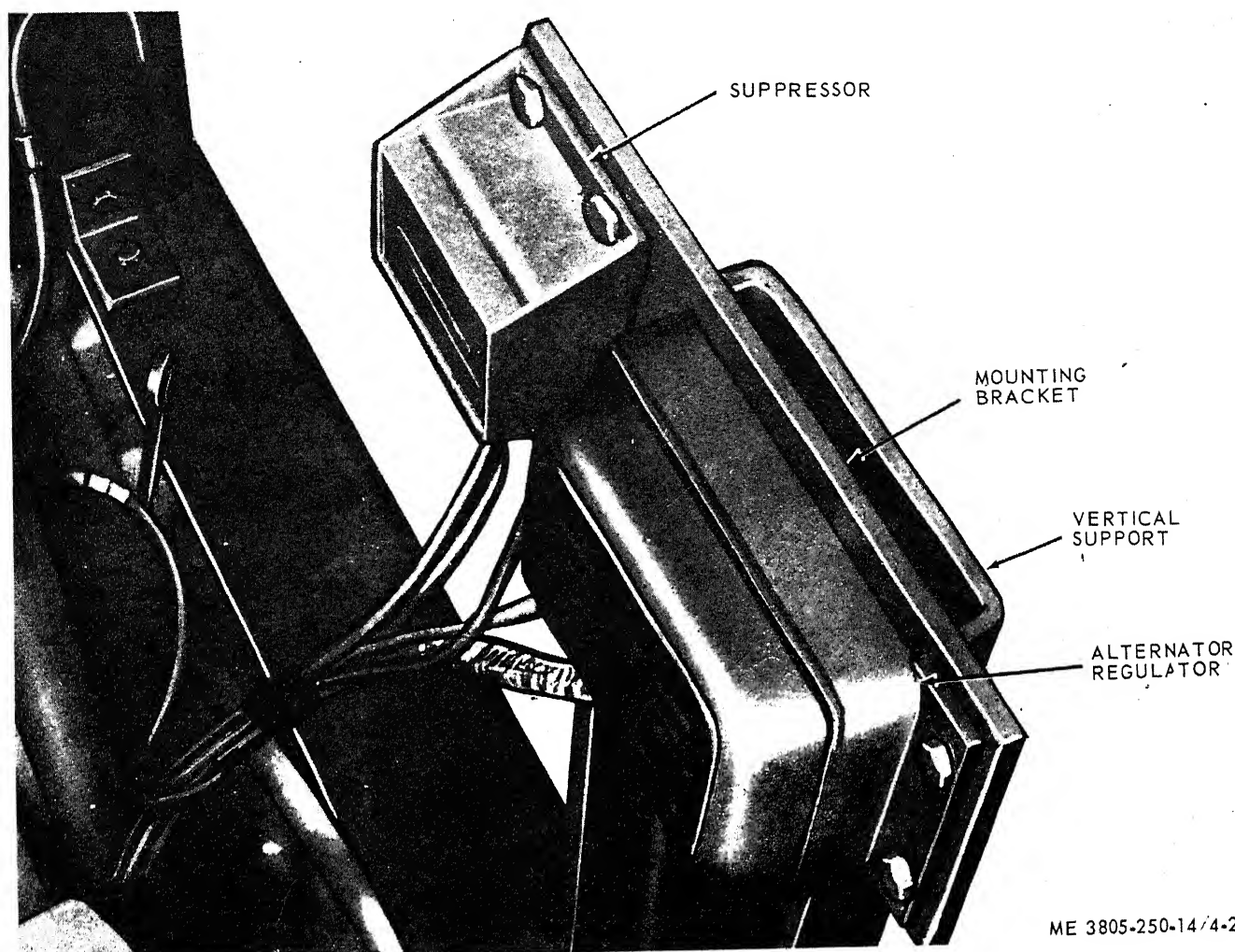
(7) Install the radiator (para. 6-16) and fill the cooling system. Check connections for leaks.

Page 4-19, figure 4-20 is replaced by the following illustration:

Page 4-21, paragraph 4-31d(1), change line 1 "Raise or lower the output voltage by 6 volts ..." to read "Raise or lower the output voltage by 0.6 volts ..."

Page 4-23, change paragraph 4-34b to read, "b. Testing and Charging. Refer to TM 9-6140-200-15 Maintenance of Storage Batteries Lead-Acid Type. Use a hydrometer and determine the condition of the batteries."

Page 4-24, figure 4-28 is replaced with the following illustration:



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Figure 4-20. Alternator, regulator, and suppressor, removal and installation.

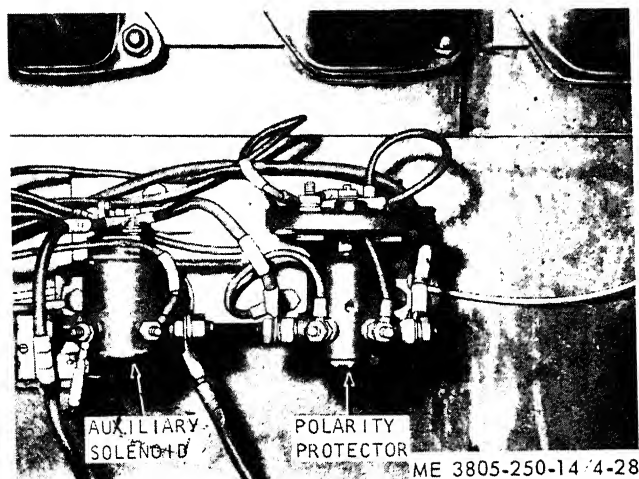


Figure 4-28. Auxiliary solenoid and reverse polarity protector, removal and installation.

Page 4-24, paragraph 4-35, behind subparagraph c add:

*"d. Reverse Polarity Protector*

(1) *General.* The reverse polarity protector mounted on the electrical components bracket above the starter protects the alternator if the batteries are reversed connected.

The protector consists of two major parts. A diode-heat sink assembly and a solenoid switch. The diode, will allow positive battery potential to flow one way only. When batteries are correctly connected, positive battery potential will flow through diode to the solenoid, which closes the circuit to the alternator and auxiliary solenoid.

(2) *Removal*

(a) Place the master switch in the *OFF* position and disconnect the battery ground cable.

(b) Tag and disconnect all wiring from the reverse polarity protector terminals, fig. 4-28.

(3) *Installation*

(a) Install reverse polarity protector by reversing the removal procedure.

(b) Connect the battery ground cable.

(c) Check the operation of the protector.

Page 4-29, paragraph 4-42, on the second line of subparagraph *a* change "front of the transmission" to read "front differential."

Subparagraph *c* is changed to read, "Loosen locknut a turnbuckle and adjust the cable to obtain a firm lock when snapped over."

In paragraph 4-42 (b) change "1.1 inches" to read "1 1/8 inches."

In figure 4-38, the illustration is replaced by the following corrected illustration:

Page 4-32, paragraph 4-46a (1), lines 2 and 3, the second sentence is changed to read, "Install the safety link."

In figure 4-44 the callout "O-Ring" is changed to read "Preformed Packing."

Page 4-33, paragraph 4-47b is changed to read:

"b. *Service.* Check the steering gear lubricant every 500 hours by removing the pipe cap from the fill and level check tube in the floor of the operator's compartment. Maintain oil level to be visible in the tube. Refer to LO 5-3805-250-12 for the correct lubricant."

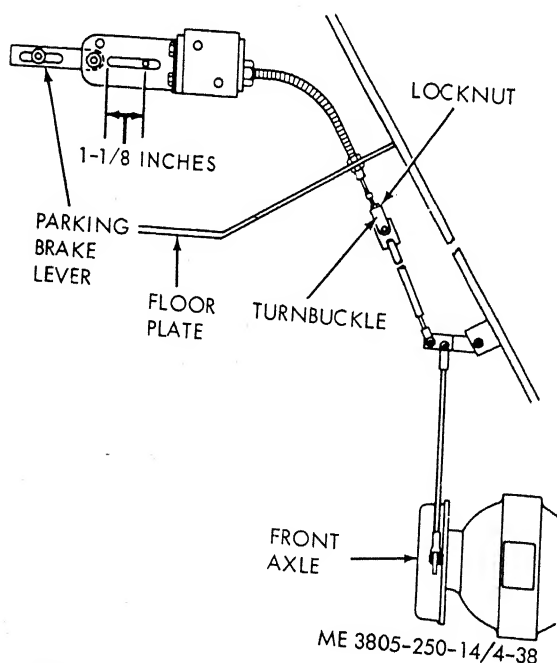


Figure 4-38. Parking brake lever adjustment.

Page 4-34, paragraph 4-57 *a* through *h*, is changed to read,

**"4-57. Hydraulic Oil Reservoir Service**

*a.* Refer to current Lubrication Order for intervals.

*b.* Close the air valve on the hydraulic reservoir and slowly withdraw the dipstick (1, fig. 3-5). Retain the gasket (2).

*c.* Remove nuts (3) and lockwashers (4) securing the top cover (5). Remove the cover and the gasket (6).

*d.* Remove two drain plugs from the bottom of the reservoir and allow the oil to drain.

*e.* Remove the breather (7) and check for restrictions. Clean in solvent.

*f.* Remove the inlet filter screen (8) and clean in solvent.

*g.* Remove the relief valves (9).

*h.* Remove and discard the filter elements (10).

*i.* Clean the inside of the reservoir (11) with a lint-free cloth.

*j.* Install new filter elements (10). Install the relief valves (9), inlet filter screen (8), breather (7), drain plugs, gaskets (6) and top cover (5). Secure cover with nuts (3) and lockwashers (4). Tighten the cover nuts to a torque of 30 to 40 foot-pound.

*k.* Fill the reservoir with 20.8 gallons of hydraulic oil. Refer to the Lubrication Order.

*l.* Install the gasket (2) and the dipstick (1).

*m.* Open the air valves at the reservoir and start the engine. Do not operate the engine over low idle speed until the air pressure gage at the reservoir indicates between 13 and 19 psi.

*n.* Operate the bucket through a complete cycle and turn the steering wheel to the extreme right and left.

*o.* Shut the engine and close the air valve.

*p.* Check the oil level with the dipstick. Add oil if necessary and repeat steps *m* through *o*.

Page 4-35, paragraph 4-59b (1), subparagraph (b) is changed to read,

"(b) Remove microswitch mounting plate and disconnect ball joints (8) from the loader control spools. Remove joints and locknuts (9)."

Page 4-37, figure 4-47 in the legend, item 4 "Bolt" and item 24 "Bolt" are changed to read "4. Nut" and "24. Nut".

Page 4-38, figure 4-50, the illustration is replaced with the following corrected illustration:



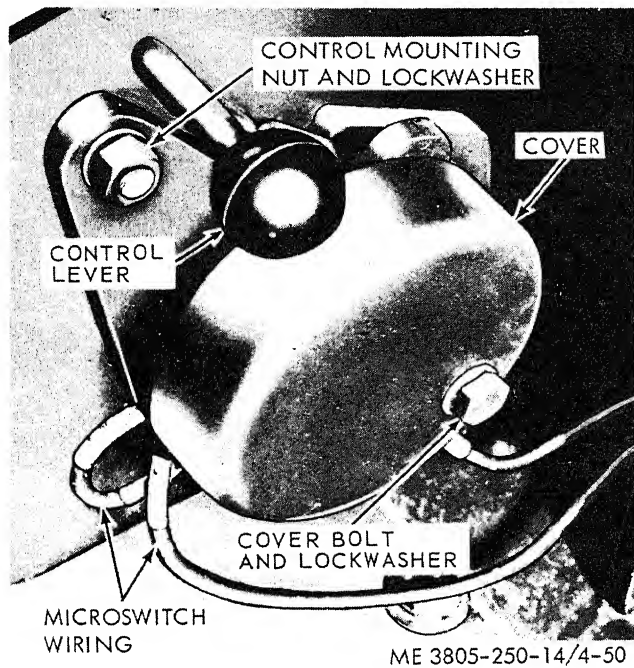


Figure 4-50. Bucket height kickout control, removal and installation.

Page 4-42, paragraph 4-65c, subparagraph (1) is changed to read "1. Loosen the two air compressor mounting bolts (fig. 4-54)".

Add paragraph 4-66 to Section XXIV as follows:

#### "4-66. Air Compressor

a. Removal. Refer to figure 4-54.

(1) Block the wheels and apply the parking brake.

(2) Remove the right engine side panel.

(3) Drain the air reservoirs (para. 3-19).

(4) Disconnect the inlet hose, outlet hose, governor outlet line, oil inlet line and oil outlet line from the air compressor. Disconnect lines to the alcohol evaporator. Cap or plug lines and fitting as soon as they are disconnected.

(5) Loosen the hook bolts and slide the compressor inward to release the belt.

(6) Remove the mounting bolts, and remove the air compressor from the loader.

#### b. Installation.

(1) Install the air compressor in the reverse order of removal (subparagraph a).

(2) Adjust the belt tension (para. 4-65). Figure 4-54, the illustration is replaced with the following corrected illustration:

Page 5-2 and 5-3, Table 5-1 is changed as follows:

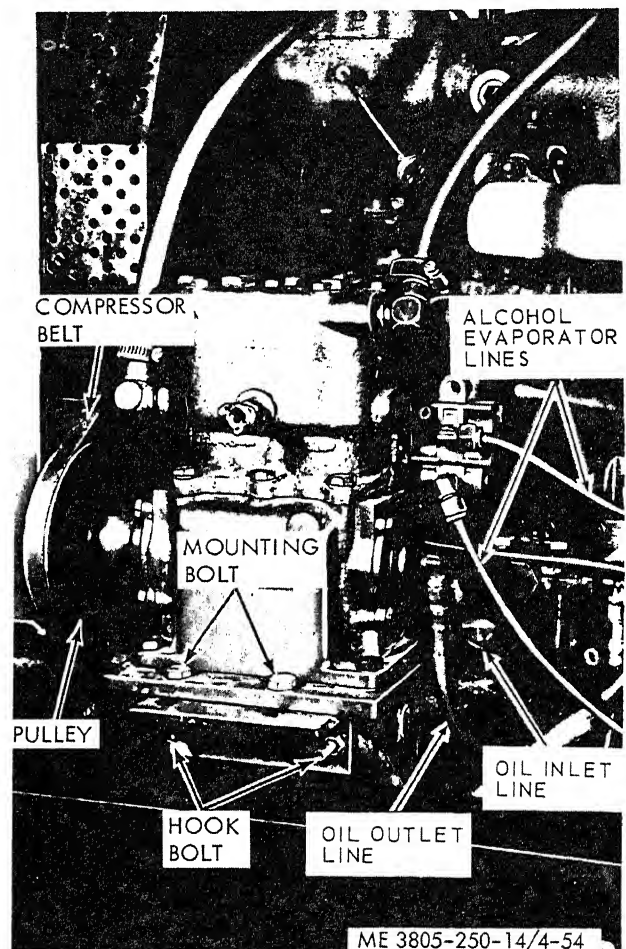


Figure 4-54. Air compressor.

Table 5-1. Special Tools and Equipment (Including Fabricated Items)

Item	Reference number	Reference		Use	Figure (fabricated items)
		Figure	Paragraph		
Clamping bar		6-38	6-20	Check cylinder sleeve protrusion	5-1
Ball	A28312	6-38	6-20	Check cylinder sleeve protrusion	
Plate	970-14C	6-38	6-20	Check cylinder sleeve protrusion	
Locating dowel	CF83-4	6-39	6-20	Cylinder head installation	
	A40953				
Tongs	CF83-1	6-40	6-20	Cylinder head installation	
	A40952				

Table 5-1. Special Tools and Equipment (Including Fabricated Items)—Continued

Item	Reference number	Reference Figure	Reference Paragraph	Use	Figure (fabricated items)
Puller set		6-54	6-24	Camshaft bushing removal and installation	
Seal installing tool		6-55	6-24	Crankshaft front seal installation	
Pump assembly		6-15	6-3	Testing fuel injectors	
Fuel injector tool kit	66-0010	6-13	6-3	Cleaning and servicing fuel injectors	
Torque wrench adapter	N7857	6-36	6-20	Removing and installing cylinder heads	
Sleeve puller kit		6-47	6-2	Removing cylinder sleeves	
Ring compressor		6-49	6-21	Installing piston ring assemblies	
Ring expander		6-46	6-21	Removing piston rings	
Voltmeter and ammeter		8-6	8-3	Testing electrical circuitry	
Growler		8-7	8-3	Testing starter armature	
Alternator service set		8-1	8-2	Servicing alternator	
Puller set				Miscellaneous bearing pulling and installation	
Spanner wrench	D44116	8-23		Remove and install lift cylinder gland	
Spanner wrench	D44115	8-23	8-13	Remove and install tilt cylinder gland	
Spanner wrench	D44112	8-23	8-13	Remove and install clam and steering cylinder glands	
Flowmeter		8-9		Check hydraulic pump output	
Brake spring pliers		8-10	8-7		
		7-30	7-21	Remove and install brake shoe return springs	
Bearing driver			7-14	Installing wheel hub bearing cups	5-2
Bearing driver			7-14	Installing planetary drive internal gear hub bearing cone	5-3
Bearing driver			7-13	Installing differential case half bearing cones	5-4
Bearing driver			7-13	Installing differential outer pinion bearing cone	5-5
Bearing driver			7-13	Installing differential pinion bearing cage cup	5-6
Bearing driver			7-13	Installing differential pinion bearing cage cup	5-7
Bearing driver			7-13	Installing differential pinion inner bearing	5-8
Seal driver			7-14	Installing wheel hub seal	5-9
Torque wrench adapter bar		7-27	7-14	Checking wheel hub bearing pre-load	5-10
Spindle nut socket		7-25	7-14	Removing and installing wheel spindle nuts	5-11
Puller set		7-3	7-2	Loosening torque converter pump bearing	5-12
Wiper removal tool			8-12	Removing clam spool wiper	5-13
Planetary pin staking tool			7-3		5-14
Compression gage				Checking engine compression	5-14
Wrench comb, 10MM	OEXM10 (5120-177-7325)	6-5	Items 1 & 5		
		6-7	Items 7, 25, 37, 43, 54, 68, 70		
Wrench comb, 17MM	OEXM17	6-7	Items 1 & 2		
Wrench comb, 19MM	OEX170M	6-5	Items 10 & 43		
		6-6	Item 12		
		6-7	Item 67		
Wrench comb, 23MM	OEX23M	6-5	Item 47		
		6-7	Item 35		
Allen wrench 5MM	AWM5B	6-7	Item 10		

Page 5-9, table 5-2, in the malfunction column, item 11, "Air intake system not properly" is changed to read "Air intake system not operating properly".

Page 6-1, paragraph 6-1, subparagraph b is changed to read,

"b. An electric fuel pump delivers fuel from the tank to the transfer pump mounted on the fuel injection pump. The transfer pump delivers the fuel through the 1st and 2nd stage fuel filters and back to the fuel injection pump, where the fuel is delivered under high pressure to the fuel injection nozzles and the engine cylinders. Excess fuel is returned from the fuel injectors to the fuel tank through an overflow line. Refer to figure 6-1 for a schematic diagram of the fuel system.

Figure 6-1, the illustration is replaced by the following corrected illustration.

Page 6-2, figure 6-3, item 6 "Transfer fuel pump" is changed to read, "6. Transfer fuel pump lines". Add item "10. Transfer fuel pump".

Figure 6-3, the illustration is replaced by the following corrected illustration:

Page 6-3, 6-4, 6-9, paragraph 6-2 in subparagraphs b, e (1), h, the words "fuel pump" are changed to read, "fuel injection pump".

Page 6-24, paragraph 6-10, subparagraph b (1) through (6) is changed to read,

"b. *Disassembly.*

(1) Loosen bolt (10, fig. 6-26) and allow oil trapped in the filter to drain. Remove the bolt and disassemble the gasket (11), the element (12), the cup (13), spring (14), the shell (16), and the gasket (15). Discard the element (12) and gasket (11).

(2) Remove two clamps (17) and the hose (18).

(3) Remove six bolts (25) and lockwashers (24) securing the base (33) to the oil cooler body (28). Discard the gasket (29).

(4) Remove seven bolts (23) and lockwashers (24) securing the head (1) to the body (28). Discard the gasket (9).

(5) Remove the cup plug (4) spring (3) and relief valve (2) from the head.

(6) Remove the drain cock (26) and bushing (27) from the oil cooler body (28)."

Page 6-25, figure 6-26, the illustration and legend are replaced with the following corrected illustration:

Page 6-26, paragraph 6-10, subparagraph d(1) and (2) is changed to read,

"d. *Reassembly.*

(1) Tighten bolts (23 and 25, fig. 6-26) to a torque of 35 to 42 foot pounds.

(2) Use new gaskets (9, 11, and 29), element (11), and preformed packing (32).

(3) Tighten bolt (10) to 25 foot-pounds torque".

Page 6-28, paragraph 6-15, subparagraph a and e are changed to read as follows:

"a. *Removal.* Refer to (para. 4-29.1) and remove the water pump".

"e. *Installation.* Refer to (para. 4-29.1) and install the water pump".

Page 6-31, paragraph 6-17 is changed to read as follows:

#### **"6-17 Fan Assembly.**

For removal and installation of the fan assembly refer to (para. 4-26.1)".

Page 6-52, after paragraph 6-25 add paragraph 6-26 as follows:

#### **"6-26 Compression Pressure Check**

a. Clean the engine thoroughly, preferable by steam cleaning.

b. Before cranking the engine, make sure all operating controls are in neutral, brakes are set and the wheels are securely blocked.

c. There are two methods of checking compression pressure, the cranking method and the engine running method.

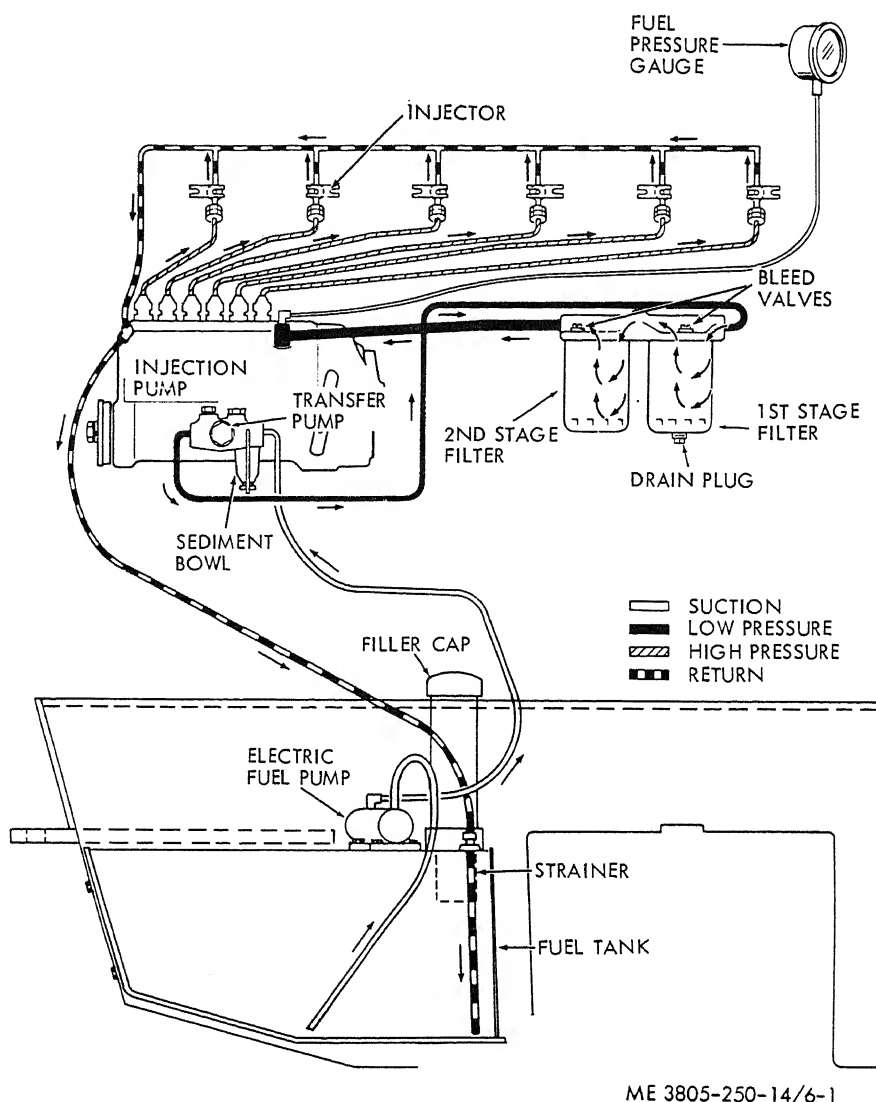
#### **NOTE**

The engine must be at operating temperature for either method.

(1) *Cranking Method.* Close the needle valve at the fuel tank. Disconnect all high pressure fuel lines and leak-off lines between injectors. Remove all injectors. Refer to table 6-1.

(2) *Running Method.* Disconnect the high pressure fuel line and leak-off lines from number one injector. Using an appropriate length of tubing or hose, route the fuel from these lines back to the fuel tank or a clean container. Remove the number one injector. Refer to table 6-1.

d. Clean the injector bores of loose carbon and residue. Replace the compression seal in the injector bore of the cylinder to be checked and install the compression gage adapter, figure 6-57. Secure it with an original injector clamp assembly and spacer, figure 6-57 (inset A). Tighten the bolt to 20 foot-pounds. Connect the compression gage to the adapter, figure 6-58. It is essential that all cylinder pressures be approximately alike. For the allowable compression variation, refer to table 6-1.



ME 3805-250-14/6-1

Figure 6-1. Fuel system schematic diagram.

e. If the compression is greater than the quantity mentioned, carbon deposits are indicated. If the reading is below these quantities, leaking valves or excessive ring clearance is indicated.

#### NOTE

To make a simple check when a compression leak is indicated, squirt a small amount (a teaspoon) of oil into the cylinder and recheck the compression. If the pressure rises to near normal, compression lost is past the rings. Very little change in compression indicates leakage

past the valves. A low pressure reading will cause difficulty in starting, particularly at low temperatures.

Take several compression readings on each cylinder. This is done by pressing the vent valve button, figure 6-58 to relieve gauge pressure. When the button is released the gauge will again indicate compression pressure.

f. Replace the compression seal and carbon seal on all injectors at the time of installation, see figure 6-59.

Table 6-1. Compression Pressure

	Engine Speed	Normal Compression Pressure	Allowable Variation Between Cylinders
Cranking			
Running	Approximately 200 RPM 800 RPM	400 PSI* 480 PSI	25 PSI 20 PSI

\*A 4% reduction in PSI must be allowed for every 1000 ft. above sea level.

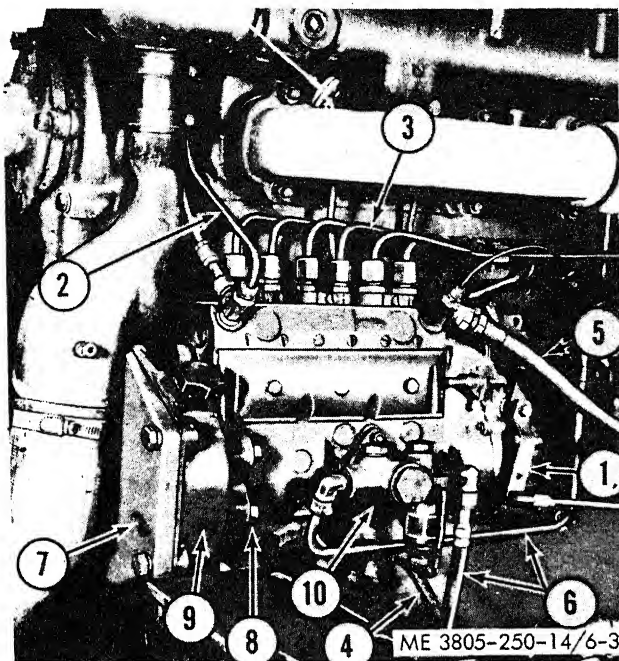


Figure 6-3. Fuel injection pump, removal and installation.

Figures 6-57, 6-58 and 6-59 are added as follows:

Page 7-37, paragraph 7-20 is changed as follows:

## **"7-20. Parking Brake**

### *a. Removal and Disassembly.*

(1) Park the loader on firm level ground and block the wheels.

(2) Disconnect the front drive shaft from the parking brake yoke.

(3) Remove cotter key (5, Fig. 7-27) from pinion nut (6) and mark nut and pinion shaft for correct reassembly.

(4) Prevent the pinion flange (8) from turning, and loosen nut (6). Tighten the nut with a torque wrench until the alignment marks line up. Record the torque reading for use during reassembly. Then remove nut and washer (7).

(5) Remove brake drum (4) with flange (8) attached.

(6) Remove six brake drum mounting nuts (1), washers (3) and bolts (2). Remove flange (8) from brake drum (4).

### **NOTE**

Replacement brake drum mounting bolts are self holding, splined shank, to facilitate removal of

nuts and brake drum without flange. The bolts listed in TM 5-3805-250-35P are the splined shank bolts and the set should be installed the first time flange and drum removal is required.

(7) Remove two springs (9) and brake shoe (10).

(8) Remove the roller (11) from the actuating pawl.

(9) Remove lever (12).

(10) Remove seven bolts (13) and washers (14), and remove backing plate (15) from the bearing cover.

### *c. Reassembly and Installation.*

(1) Position backing plate (15, fig. 7-27) on bearing cover and secure with seven bolts (13) and washers (14).

(2) Install the actuator lever (12) on the pawl opposite the depression in the backing plate. Ensure that the other pawl is on top of the actuator lever, and install roller (11) on the pawl.

(3) Position the brake shoes (10) on the backing plate, and install return springs (9).

(4) Position flange (8) in brake drum (4) and secure with bolts (2), washers (3) and nuts (2).

(5) Install flange (8) and brake drum (4) assembly, and washer (7) and nut (6). Tighten the nut to torque value determined during disassembly. Secure with cotter key (5)."

Page 8-23, paragraph 8-12, in subparagraph a, step 3 becomes step 6. Step 6, 7 and 8 are changed to steps 7, 8 and 9.

Step 11 is changed to read as follows:

"(11) Support the valve and remove the remaining mounting nut and lockwasher. Remove the valve from the loader. Note the position of the short bolt and reinstall it in the same position."

Page 8-35, paragraph 8-15, subparagraph a is changed to read as follows:

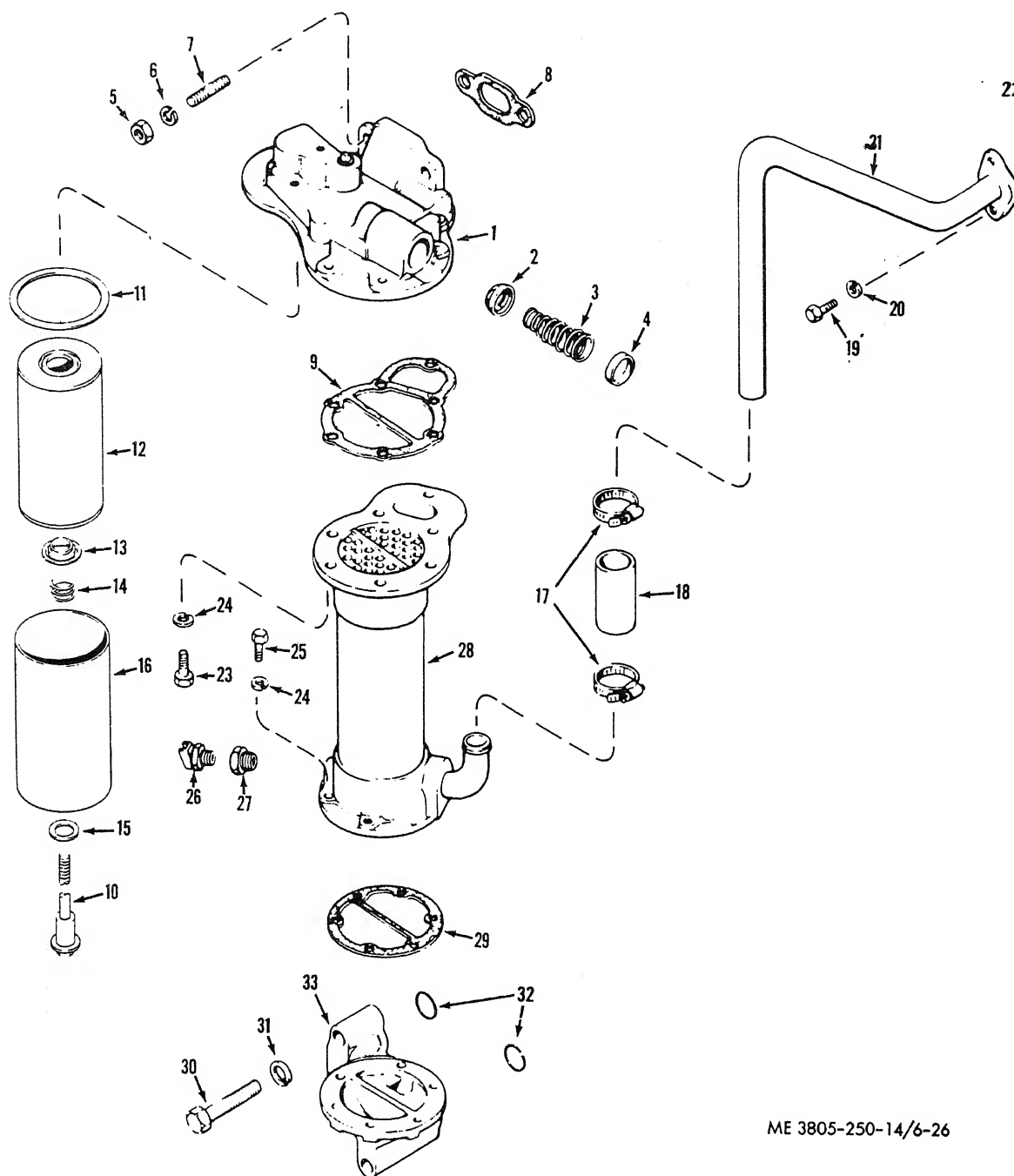
"a. Removal. Refer to paragraph 4-66 and remove the air compressor."

Page 8-36, "Figure 8-25. Air Compressor, removal and installation" is deleted.

Page 8-42, paragraph 8-15, subparagraph e is changed to read:

"e. Installation. Refer to paragraph 4-66 and install the air compressor."

Page B-3, B-4, and B-5; Section II and IV; the maintenance allocation chart is superseded by the following:



ME 3805-250-14/6-26

- |               |                |                |
|---------------|----------------|----------------|
| 1. Head       | 12. Element    | 23. Bolt       |
| 2. Valve      | 13. Cup        | 24. Lockwasher |
| 3. Spring     | 14. Spring     | 25. Bolt       |
| 4. Cup Plug   | 15. Gasket     | 26. Drain Cock |
| 5. Nut        | 16. Shell      | 27. Bushing    |
| 6. Lockwasher | 17. Clamps     | 28. Body       |
| 7. Stud       | 18. Hose       | 29. Gasket     |
| 8. Gasket     | 19. Bolt       | 30. Bolt       |
| 9. Gasket     | 20. Lockwasher | 31. Lockwasher |
| 10. Bolt      | 21. Tube       | 32. Packing    |
| 11. Gasket    | 22. Gasket     | 33. Base       |

Figure 6-26. Oil cooler and oil filter assembly, exploded view.

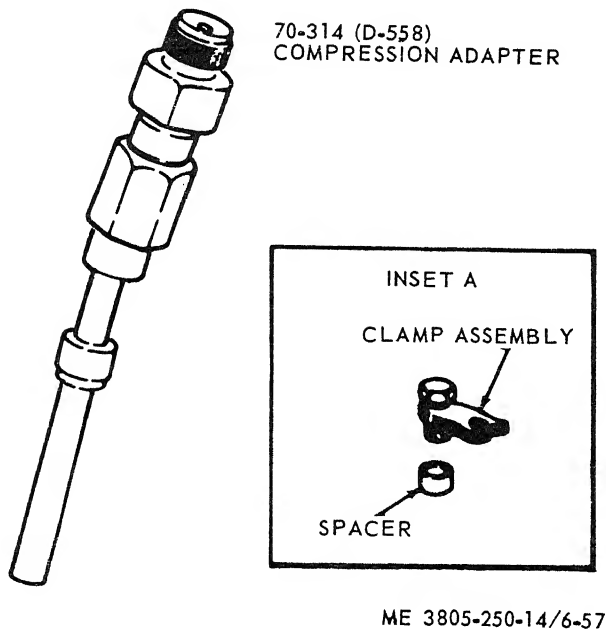


Figure 6-57. Compression adapter.

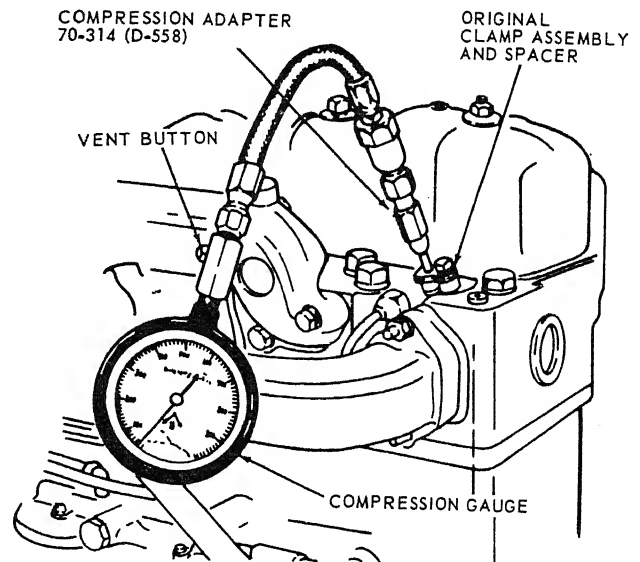


Figure 6-58. Compression gauge.

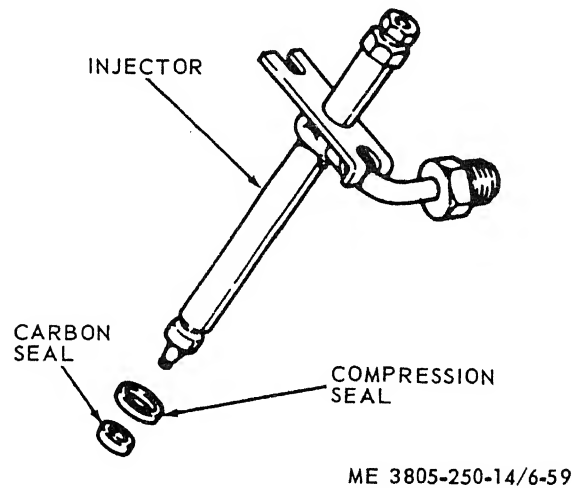


Figure 6-59. Fuel injector.



## SECTION II. MAINTENANCE ALLOCATION CHART

FOR

Loader, Scoop Type, 2 1/2 Cu. Yd. Hing. Frame Steer

J. I. Case Mil. MW24 FSN 3805-253-0627

(1) Group No.	(2) Functional Group	(3) Maintenance Functions											(4) Tools and Equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
01	ENGINE ASSEMBLY													
	Engine Diesel	C	F	C						F	F	D	D	A
	Head, Cylinder									F	H	D	D	B
	Crankshaft	H								F				C
	Flywheel Assembly									F	F			D
	Valves & Seat Inserts									H	H			
	Arm Assy, Rocker				F					F	F			
	Pistons, Rings & Pins	H								H				
	Rods, Connecting & Bearing									H	H			
	Camshaft & Timing Gears	H								H	H			
	Pan, Oil									H	H			
	Pump, Lube Oil									H	H	D		
	Cooler, Oil									F	F			
	Regulator, Oil Pressure									F	F			
	Filter, Assy, Oil			O						O				
	Breather, Crankcase			O						O				
02	FUEL SYSTEM													
	Injector, Fuel			F						F		D	D	
	Pump, Fuel Injection									F	F	D	D	
	Pump, Electric									O	F			
	Filter, Fuel									O				
	Air Cleaner													
	Turbocharger									F	H	D	D	
	Starting Aids									O	O			
	Throttle, Controls					O				O	O			E
	Tank, Lines & Fittings									O				
03	EXHAUST SYSTEM													
	Pipes & Clamps									O	O			
04	COOLING SYSTEM													
	Radiator									F	F			
	Water Pump									O	F			
	Fan Assy									O	O			
	Thermostat	O								O				
	Belts	C				O				O				
05	ELECTRICAL SYSTEM													
	Alternator			O						O	F	H	H	
	Regulator, Alternator			O		O				O				
	Starting, Motor			O						O	F	H	H	
	Batteries, Storage			O						O				
	Belts	C				O				O				
	Instrument Panel													
	Gages, Switches, Wiring	C								F				
	Miscellaneous Items													
	Warning Devices			O						F				
	Sending Units			O						O				
	Horn									O	O			
	Hourmeter									O		H		
	Receptacle, Slave Cable									O	O			
	Lights	C								O	O			
	Chassis Wiring Harness									F	O			



(1) Group No.	(2) Functional Group	(3) Maintenance Functions											(4) Tools and Equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
06	TRANSMISSION ASSEMBLY													
	Transmission Assy			O					F	F	D	D		
	Control Valve								F	H	D	D		
	Pump								F	H	H			
	Filter, Oil			O					O					
	Strainer, Oil			O					O					
	Control Levers and Linkage			O					O	O				
07	PROPELLER SHAFTS													
	Shafts Propeller			O					O	O				
08	FRONT AXLE													
	Front Axle Assy	C		O					F	F	D	D		
	Differential			O					H	H	D	D		
	Planetary Drive			O					F	F	D	D		
	Axle Shaft	F							F					
	Breather			O					O					
09	REAR AXLE													
	Rear Axle Assy	C		O					F	F	D	D		
	Differential			O					H	H	D	D		
	Planetary Drive			O					F	F	D	D		
	Axle Shaft	F							F					
	Breather			O					O					
10	BRAKES													
	Hand Brake													
	Brake Hand				O				F	F				
	Lever & Linkage				O				O	O				
	Service Brake													
	Brakes, Service				O				F	F				
	Hydraulic Brake System													
	Power Cluster								F	F				
	Wheel Cylinder								F	F				
	Hoses & Lines	O							O					
	Air Brake System								F	F				
	Chambers													
	Hoses, Fittings & Lines	C							O					
	Reservoir Air			C					O	O				
	Treadle Valve								O	F				
11	WHEELS													
	Wheels	C							O					
	Drums								F	F				
	Tires & Rims			C					O	O				
12	STEERING													
	Steering Assy			O	F				F	F				
	Link, Drag, Tie Rod &	C							O					
	Steering Wheel													
	Valves, Hydraulic	C							F	F	D			
	Cylinders, Hydraulic	C							F	F	D			
	Hoses, Lines & Fittings	C							O	O				
13	BODY & HOOD													
	Hood, Panels, Shrouds								O	O				
	Floor Plates								O	O				
	Seat				C				O	O				
14	HYDRAULIC LIFT COMPONENTS													
	Hydraulic Pump			F					F	F	H			
	Control Valves			F					F	F	H			
	Control Levers & Linkage	C			O				O	O				

(1) Group No.	(2) Functional Group	(3) Maintenance Functions											(4) Tools and Equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
15	Hydraulic Cylinders	C							O	F				
	Boom, Bucket, Clam													
	Hydraulic Tank	C		C					F	F				
	Filters, Strainer			O					O	O				
	Breather			O					O					
	PNEUMATIC, EQUIPMENT													
	Air Compressor Assy			O					O					
	Crankcase, Block								H	H				
	Cylinder Head								F	F				
	Piston, Connecting Rods								H	H				
	Valves, Unloader								H	H				
	Crankshaft								H	H				
	Air Governor	O				O			O					
	Belt					O			O					
16	EARTH MOVING EQUIPMENT													
	Bucket Assy								O		F			
	Edge, Cutting	C							O					
	Point & Tooth	C							O					
	Lift Arms, Bar, Boom Carrier				O				F	F				
17	SHAFTS, PINS, LATCHES				O	O			O	O				
	FRAME													
	Frame Assembly	C							H	H				

## SECTION IV

## Maintenance Allocation Chart

FOR: Loader, Scoop Type, J. I. Case

DATE 26 July 1971

Mdl. MW24, 3805-253-0627

PAGE 1 OF 1

Reference Code	Remarks
A-B	Test includes engine operation and compression.
B-K	Rebuild includes align, metalize and resize.
C-H	Replace ring gear.
D-H	Reface valves.
E-C	Service includes draining water.

Pages C-1, C-2, C-3, C-4 and C-5, the entire Appendix C is changed to read as follows:

## APPENDIX C

### BASIC ISSUE ITEM LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED

#### Section I. INTRODUCTION

##### 1. Scope

This appendix lists basic issue items, items troop installed or authorized which accompany the MW24 Scoop Loader and required by the crew/operator for operation, installation, or operator's maintenance.

##### 2. General

This basic issue items, items troop installed or authorized list is divided into the following sections:

*a. Basic Issue Items List—Section II.* A list, in alphabetical sequence, of items which are furnished with and which must be turned in with the end item.

*b. Items Troop Installed or Authorized List—Section III.* A list, in alphabetical sequence of items which at the discretion of the unit commander may accompany the end item, but are NOT subject to be turned in with the end item.

##### 3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items List, Section II, and Items Troop Installed or Authorized, Section III.

*a. Source, Maintenance, and Recoverability Code(s) (SMR):*

(1) Source code, indicates the source for the listed item. Source Codes are:

Code	Explanation
P ----	Repair parts, special tools and test equipment supplied from GSA/DSA or Army supply system and authorized for use at indicated maintenance levels.
P2----	Repair parts, special tools and test equipment which are procured and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.

(2) Maintenance code, indicates the lowest level of maintenance authorized to install the listed item. The maintenance level code is:

Code	Explanation
C----	Crew/Operator

(3) Recoverability code, indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are nonrecoverable. Recoverability codes are:

Code	Explanation
R----	Applied to repair parts (assemblies and components), special tools and test equipment which are considered economically repairable at direct and general support maintenance levels.
S----	Repair parts, special tools, test equipment and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis.

*b. Federal Stock Number.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description.* This column indicates the Federal item name and any additional description of the item required.

*d. Unit of Measure (U/M).* A 2 character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

*e. Quantity Furnished With Equipment (BIIL only).* This column indicates the quantity of an item furnished with the equipment.

*f. Quantity Authorized (Items Troop Installed or Authorized Only).* This column indicates the quantity of the item authorized to be used with the equipment.

*g. Illustration (BIIL only).* This column is divided as follows:

(1) *Figure Number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item Number.* Indicates the callout number used to reference the item in the illustration.

## Section II. Basic Issue Items List

(1) SMR Code	(2) Federal Stock No.	(3) Description  Ref No. & Mfr Code                      Usable on Code	(4) Unit of Meas	(5) Qty furn with Equip	(6) Illustration	
					(A) Fig No.	(B) Item No.
		NOT APPLICABLE				

## SECTION III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) SMR Code	(2) Federal stock No.	(3) Description  Ref No. & Mfr Code                      Usable on code	(4) Unit of Meas	(5) Qty Auth
PC	4210-889-2221	Extinguisher, Fire: Dry, 1 Hand Type, 2 1/2 lb. Fed. Spec. O-E-95, Type III, Class 2, Walter Kidde, P/N 874195 or equal	EA	1
PC	4930-360-2801	Grease Gun, Lever, Actuated 16 oz.	EA	1
PC	4930-430-3264	Hose, Flex, Grease Gun	EA	1
PC	5120-449-8083	Wrench, Adj. 10"	EA	1
PC	5120-223-7397	Pliers, Slip Joint 8"	EA	1
PC	5120-752-9675	Screw Driver, Flat Tip 6" long	EA	1
PC	5120-278-0330	Wrench, Drain Plug Comb. Head	EA	1

Figure 1-3 foldout located in the back of the manual is replaced as follows:

*Figure 1-3. Wiring diagram.*

(Located in back of manual)

By Order of the Secretary of the Army:

W. C. WESTMORELAND,  
*General, United States Army,*  
*Chief of Staff.*

Official:

VERNE L. BOWERS,  
*Major General, United States Army,*  
*The Adjutant General.*

Distribution:

To be distributed in accordance with DA Form 12-25B, Line B-28 Organization and Maintenance requirements for Earth Moving Equipment: Loaders (qty rqr block 402)

CHANGE }  
No. 5 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC, 20 May 1980

**Operator, Organizational, Direct Support and General Support  
Maintenance Manual  
LOADER, SCOOP-TYPE, DED, 4-WHEEL DRIVE, PNEUMATIC TIRED,  
HINGED-FRAME STEER, 2-1/2 CU. YD. MULTI-PURPOSE BUCKET,  
(J. I. CASE MODEL MW-24)  
NSN 3805-00-253-0627**

TM 5-3805-250-14, 2 December 1970, is changed as follows:

*Inside cover.* Add to DURING OPERATION:

Depress brake pedal fully to relieve transmission pressure before shifting lever to change direction of travel.

Add the following warnings to the list of safety precautions:

**WARNING**

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

**WARNING**

Drycleaning solvent, P-D-680, used to clean parts, is potentially dangerous to

personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F. — 138°F.

*Page 1-1*, paragraph 1-4 is superseded as follows:

**1-4. Reporting Errors and Recommending Improvements**

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Tank-Automotive Materiel Readiness Command, ATTN: DRSTA-MBP, Warren, MI 48090. A reply will be furnished direct to you.

*Page 2-1.* Immediately following chapter 2 title, add the following:

**WARNING**

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

Paragraph 2-1h is added as follows:

h. Check all propeller shaft bolts for 30-35 lb torque upon initial deprocessing and during *before operations* check for first 50 hours. Assure that shaft spider and bearing assemblies are adequately lubricated upon deprocessing and every 50 hours thereafter in accordance with lubrication order.

*Page 2-8.* Paragraph 2-12b(2) is superseded as follows:

(2) To change direction (forward-to-reverse or reverse-to-forward), release accelerator, apply the brake and bring the loader to a complete stop

before moving transmission control lever to change direction of travel. The transmission is equipped with an air cylinder that is connected to the "Low forward" clutch pack. When the selector valve is in the "Low forward" position and the air brake treadle valve is depressed, the air cylinder is actuated and dumps the "Low forward" clutch pack.

**CAUTION**

Failure to completely stop the loader prior to changing direction of travel could seriously damage the transmission propeller shaft and universal joints.

\*This change supersedes C 4, 8 July 1974.

Page 1-6, change title "General Torques" to read "Table 1-1, General Torques".

Paragraph "(39) Wiring diagram" is changed to read "(40) Wiring diagram."

Page 2-2, paragraph 2-5a, change the end of the sentence "transported at low speed" to read "transported at 10 MPH or less."

Paragraph 2-5b, change sentence "When towing or pushing the loader for distances greater than 1/2 mile or at high speed refer to organizational maintenance personnel to disconnect the drive line shafts." to read "When towing or pushing the loader for distances greater than 1/2 mile or at speeds over 10 MPH refer to organizational maintenance personnel to disconnect front and rear drive line shaft at the differentials".

Page 2-2, paragraph 2-6 "long distance moving of the loader should be accomplished with suitable transportation equipment such as a flat bed truck trailer or a railroad car. Tiedown and block the load securely and perform the following operation" is changed to read "Long distance moving of the loader should be accomplished with suitable transportation equipment such as a flat bed truck or a railroad car. Tiedown and block the loader securely. For tiedowns faired toward the rear, attach cables or chains to the rear lifting-tiedown eyes, pintle hook, and lower frame members just forward of the steering joint.

Subparagraphs 2-6a, b, and c remain unchanged.

Page 2-3, in figure 2-2, the illustration is replaced by the following corrected illustration:

Page 2-5 in figure 2-4, note 4 is changed to read:

"4. Turn Signal and Emergency Flasher Switch.

Push lever upward to operate left turn signal lights. Pull lever down to operate right turn signal lights. Pull short lever out while pulling long lever into slot and down to operate emergency flasher lights.

In figure 2-4, the illustration is replaced by the following corrected illustration:

Page 2-7 in figure 2-6, the illustration is replaced by the following corrected illustration:

Page 2-10, change note to read "If the loader begins to stall, touch the brake lightly and move the bucket control lever toward the Retract Bucket".

Page 3-2, table 3-1, add step 13, in item column add, "End item" and in the Procedure column add "For lubrication refer to LO 5-3805-250-12".

Page 3-4, figure 3-2, add another item to the legend after item 8 add: "9. Unloader".

Page 3-5, paragraph 3-10, Fuel Filter Service is changed to read as follows:

### "3-10. Fuel Filter Service

a. Remove the right engine side panel.

b. Close the fuel tank shut-off valve and remove the drain plugs from the filters, (fig. 3-4).

c. Unscrew case bolt and remove the case with the filter.

(1) First stage: Remove the strainer and wash it in a solvent.

(2) Second stage: Remove the filter element and discard. Install a new element and case gasket.

d. Install the case with filter and tighten the case bolt.

e. Remove the fuel sediment bowl and strainer from the transfer pump, (fig. 6-3). Wash the strainer in solvent. Replace if damaged. Install the strainer and bowl.

f. Open the fuel shut-off valve.

g. Open the bleed valve on the first stage filter and start the electric fuel pump. When clear, bubble-free fuel appears, close the bleed valve.

h. Install the engine side panel.

Paragraph 3-11, change subparagraph "a." to read "a. Inspection (fig. 3-5)."

Delete subparagraph b(1) through (17) and add "b. Service. The servicing of the reservoir is performed in Organizational Maintenance, see para. 4-57."

Page 3-5, in figure 3-4, the illustration is replaced by the following corrected illustration:

Page 3-7, paragraph 3-16b "Check belts for proper adjustment. Deflection should be one-half inch at a point midway between the pulleys when a pressure of 60 pounds is applied." is changed to read "Check belts for proper adjustment. Deflection should be one-half inch at a point midway between the pulleys."

Page 4-1, paragraph 4-4 "Organizational maintenance personnel will be required to use Battery Tester 6625-647-4112 (BST5) for battery testing procedures. Refer to paragraph 4-34", is changed to read, "Special tools required to perform organizational maintenance on the loader are listed in table 4-1."

Paragraph 4-9 line 1, change "table 4-1" to read "table 4-2."

Paragraph 4-9 on line 3, at the end of the paragraph add "A quarterly interval is defined as 250 hours of operation or 3 calendar months, whichever occurs first".

## Leakage Definitions for Operator/Crew PMCS

- CLASS I** Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
- CLASS II** Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
- CLASS III** Leakage of fluid great enough to form drops but not enough the item being checked/inspected.

consideration must be given to the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported to your supervisor or to organizational maintenance.

### CAUTION

Equipment operation is allowable with minor leakage (Class I or II). Of course,

Operation of equipment is not permitted when any type of fuel leak is detected (Class I, II, or III).

Page 3-2. Table 3-1 is superseded as follows.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services  
B — Before D — During A — After W — Weekly M — Monthly

Item No.	Interval					ITEM TO BE INSPECTED Procedure: Check for and have repaired, filled, or adjusted as needed	Equipment is not ready/available if:
	B	D	A	W	M		
1	•					<p align="center"><b>NOTE</b></p> <p>PERFORM WEEKLY AS WELL AS BEFORE PMCS'S IF:</p> <p>a. You are the assigned operator but have not operated vehicle since the last weekly.</p> <p>b. You are operating the vehicle for the first time.</p> <p><b>MAKE THE FOLLOWING WALK AROUND CHECKS:</b> (Exterior of vehicle)</p> <p>a. Check for evidence of leakage (oil, fuel, hydraulic fluid or coolant) on or under the scoop loader.</p> <p>b. Check tires for damage or low pressure (correct pressure is 45 psi).</p> <p>c. Check lift, tilt, and clam cylinders for leaks (at packing gland or fittings) or damage (nicks or scoring).</p> <p>d. Check that fire extinguisher is in proper place and has proper pressure. (See TB 5-4200-200-10.)</p> <p>e. Visually check for loose, missing, or damaged parts.</p> <p><b>RADIATOR</b> Check coolant level. Fill to the overflow.</p> <p><b>V-BELTS</b> Inspect fan, alternator, and air compressor belts for frayed condition or deterioration.</p> <p><b>ALCOHOL EVAPORATOR (FREEZING TEMPERATURES ONLY)</b> Check and refill as required.</p> <p><b>BATTERIES</b></p> <p align="center"><b>WARNING</b></p> <p>Do not smoke or allow open flame in vicinity while checking or filling battery. The battery generates hydrogen, a highly explosive gas. Check level of electrolyte. If low, fill with cleanwater (distilled if possible) to the split ring. In freezing weather, run engine at least 15 minutes after adding water.</p> <p><b>AIR CLEANER</b></p> <p>a. Empty dust cup.</p> <p>b. Check indicator during operation when heavy dust conditions exist. Have serviced if indicator is red.</p> <p><b>FUEL FILTERS</b> Drain enough fuel from strainer and filter to insure removal of water and foreign particles. (Drain in suitable container for convenient disposal).</p> <p><b>AIR RESERVOIRS</b> Open drain cocks to release accumulated moisture. Close cocks.</p>	<p>Class III leakage is evident (no fuel leakage allowed).</p> <p>Tires have cuts or abrasions which would result in tire failure during operation. One or more tires missing or unserviceable.</p> <p>Belt missing, frayed, or broken.</p>
2				•			
3				•			
4	•						
5				•			
6	•	•					
7				•			
8		•					



Table 3-1. Operator/Crew Preventive Maintenance Checks and Services - Continued  
B — Before D — During A — After W — Weekly M — Monthly

Item No.	Interval					ITEM TO BE INSPECTED Procedure: Check for and have repaired, filled, or adjusted as needed	Equipment is not ready available if:
	B	D	A	W	M		
9						<b>INSTRUMENTS</b> Check for normal operating readings for the instruments as follows: (1) VOLTMETER ..... 22 - 28 volts (2) OIL PRESSURE gage ..... 44 - 55 psi (3) ENGINE TEMPERATURE gage ..... 180° - 120°F. (4) HYDRAULIC OIL PUMP INLET gage ..... 12 - 14 psi (Idling pressure) ..... 13 - 19 psi (5) CONVERTER TEMPERATURE gage ..... 250° - 360°F. (6) CLUTCH PRESSURE gage ..... 145 - 180 psi (7) AIR PRESSURE gage ..... 105 - 125 psi (8) FUEL PRESSURE gage ..... above 20 psi	Gages not within range specified.
10						<b>SERVICE BRAKES</b> During operation, check brakes for stopping ability; pulling, grabbing, or other abnormal operation.	Stopping ability impaired. Abnormal operation would result in hazardous driving conditions.
11						<b>CONTROL LEVERS AND PEDALS</b> Check for proper operation.	Improper operation evident.
12						<b>LIGHTS</b> Check for proper operation.	

Page 4-1, Section V, paragraphs 4-8 and 4-9 are superseded as follows:

## Section V. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

### 4-8. General

To insure that the scoop loader is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. Table 4-1 contains a tabulated listing of preventive maintenance checks and services to be performed by organizational maintenance personnel. All deficiencies and shortcomings will be recorded as well as the corrective action taken on DA Form 2404 at the earliest possible opportunity.

### 4-9. Organizational Preventive Maintenance Checks and Services

a. The item numbers of table 4-1 indicate the sequence of the PMCS. Perform at the intervals shown below:

- (1) Do your (Q) PREVENTIVE MAINTENANCE once each 3 months.
- (2) Do your (S) PREVENTIVE MAINTENANCE twice a year, or each 6 months.
- (3) Do your (A) PREVENTIVE MAINTENANCE once each year.
- (4) Do your (B) PREVENTIVE MAINTENANCE once each two years.
- (5) Do your (H) PREVENTIVE MAINTENANCE at the hour interval listed.
- (6) Do your (MI) PREVENTIVE MAINTENANCE

NANCE when the mileage of the vehicle reaches the amount listed.

b. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.

c. Always do your preventive maintenance in the same order, so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

d. If anything looks wrong and you can't fix it, write it down on your DA Form 2404. If you find something seriously wrong, report it to direct support as soon as possible.

### WARNING

Drycleaning solvent, used to clean parts, is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 138° F.

(1) *Keep it clean.* Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use drycleaning solvent (SD-2) to clean metal surfaces. Use soap and water when you clean rubber or plastic material.

(2) *Bolts, nuts, and screws.* Check that they are not loose, missing, bent, or broken. You can't tighten them all with a tool, of course, but look for chipped

paint, bare metal, or rust around bolt heads. Tighten any that you find loose.

(3) *Welds.* Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to direct support.

(4) *Electric wires and connectors.* Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connections and make sure the wires are in good condition.

(5) *Hoses and fluid lines.* Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, of course, but a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, either correct it or report it to direct support (refer to MAC chart, appendix B).

e. It is necessary for you to know how fluid leaks affect the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and **REMEMBER** — When in doubt, notify your supervisor!

Leakage definitions for Organizational PMCS

**CLASS I** Seepage of fluid (as indicated by wetness or discoloration not great enough to form drops.

**CLASS II** Leakage of fluid great enough to form drops but not enough to cause drops to drip from the item being checked/inspected.

**CLASS III** Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

### CAUTION

Equipment operation is allowable with minor leakages (Class I or II). Of course, consideration must be given to the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be corrected before releasing equipment for operation.

Operation of equipment is not permitted when any type of fuel leak is detected (Class I, II, or III).

Page 4-2, table 4-1 is superseded as follows:

Table 4-1. Organizational Preventive Maintenance Checks and Services

Item No.	Interval						ITEM TO BE INSPECTED Procedure
	Q-Quarterly	S-Semiannually	A-Annually	B-Biennially	H-Hours	MI-Miles	
1	.						<b>NOTE</b> PERFORM OPERATOR/CREW PMCS PRIOR TO OR IN CONJUNCTION WITH ORGANIZATIONAL PMCS IF: a. There is a delay between the daily operation of the equipment and the organizational PMCS. b. Regular operator is not assisting/participating. <b>WHEELS AND TIRES</b> a. Check torque of lug nuts. Tighten nuts to a torque of 380 to 420 pound-feet. b. Inspect tires for damage, excessive wear ( $\frac{1}{8}$ " minimum tread depth). <b>BRAKE SYSTEM</b> a. Inspect hoses, lines, tank, and connections for leaks. b. Adjust brakes as necessary. c. Check hand brake for proper operation. Adjust as necessary. <b>COOLING SYSTEM</b> a. Check radiator for damage. Remove any debris which would restrict air flow. b. Inspect hoses and lines for leaks, abrasions, and kinked or restricted areas. Check that they are securely mounted. <b>V-BELTS</b> Inspect for damage and wear, replace or adjust as necessary. Proper belt adjustment will permit a 1/2-inch deflection midway between pulleys. <b>BATTERIES</b>  <b>WARNING</b> Do not smoke or allow open flame in vicinity while checking or filling battery. The battery generates hydrogen, a highly explosive gas. Remove corrosion. Clean and tighten cable connections and mounting. Fill to approximately $\frac{3}{8}$ inch above plates. In freezing weather, run engine a minimum of 15 minutes after adding water. (See TM 9-6140-200-14).
2	.						
3	.						
4	.						
5	.						

Table 4-1. Organizational Preventive Maintenance Checks and Services - Continued

Item No.	Interval						ITEM TO BE INSPECTED Procedure
	Q Quarterly	S Semiannually	A Annually	B Biennially	H Hours	MI Miles	
6	.						FUEL SYSTEM Inspect for leaks, damage, and loose mountings. Service filters as nec

Page 8-23, paragraph 8-12f(7). Change "2250 to 3300" to "2250 to 2300".

Page A-1, paragraph A-4.

Delete the following:

TM 9-1870-1, Care and Maintenance of Pneumatic Tires

Add the following:

TM 9-2610-200-20, Pneumatic Tires and Inner Tubes and Radial Tires. TB MED 251, Noise and Conservation of Hearing.

Page B-4, Group No. 14, following line 5, B Column (2). Add "Hydraulic Lines and Fittings".

Column (3) (A) (Inspect). Add "C".

Column (3) (H) (Replace). Add "O".

Column (3) (I) (Repair). Add "O".

Foldout, figure 1-3, Wiring Diagram, Change of resistor in upper right corner connected of POLAR PROTECT form "150" to "33".

By Order of the Secretary of the Army:

Official:

E. C. MEYER  
General, United States Army  
Chief of Staff

J. C. PENNINGTON  
Major General, United States Army  
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25B, Organizational maintenance requirements for Earth Moving Equipment, Loaders.

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DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 2 December 1970

## OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT AND

## GENERAL SUPPORT MAINTENANCE MANUAL

## LOADER, SCOOP TYPE, DED, 4 WHEEL DRIVE, PNEUMATIC TIRED,

## HINGED FRAME STEER, 2½ CU. YD. MULTI-PURPOSE BUCKET,

## (J. I. CASE MODEL MW-24)

FSN 3805-253-0627

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# CHAPTER 1

## INTRODUCTION

### Section I. GENERAL

#### 1-1. Scope.

a. This manual contains instructions for use and maintenance of the MW24 Scoop Loader. It includes procedures for Operator, Organizational, Direct Support and General Support levels of maintenance for the equipment and its accessories.

b. Appendix A contains a list of publications to be used in conjunction with this manual. Appendix B contains the Maintenance Allocation Chart. Appendix C contains the Basic Issue Items List.

c. For administrative storage, refer to TM 740-90-1 and for destruction of equipment to prevent enemy use refer to TM 750-244-3.

#### 1-2. Forms and Records

For appropriate forms and records and their

application to the MW24 Scoop Loader, refer to TM 38-750.

#### 1-3. Equipment Serviceability Criteria

Refer to TM 5-3800-200-ESC.

#### 1-4. Reporting of Errors

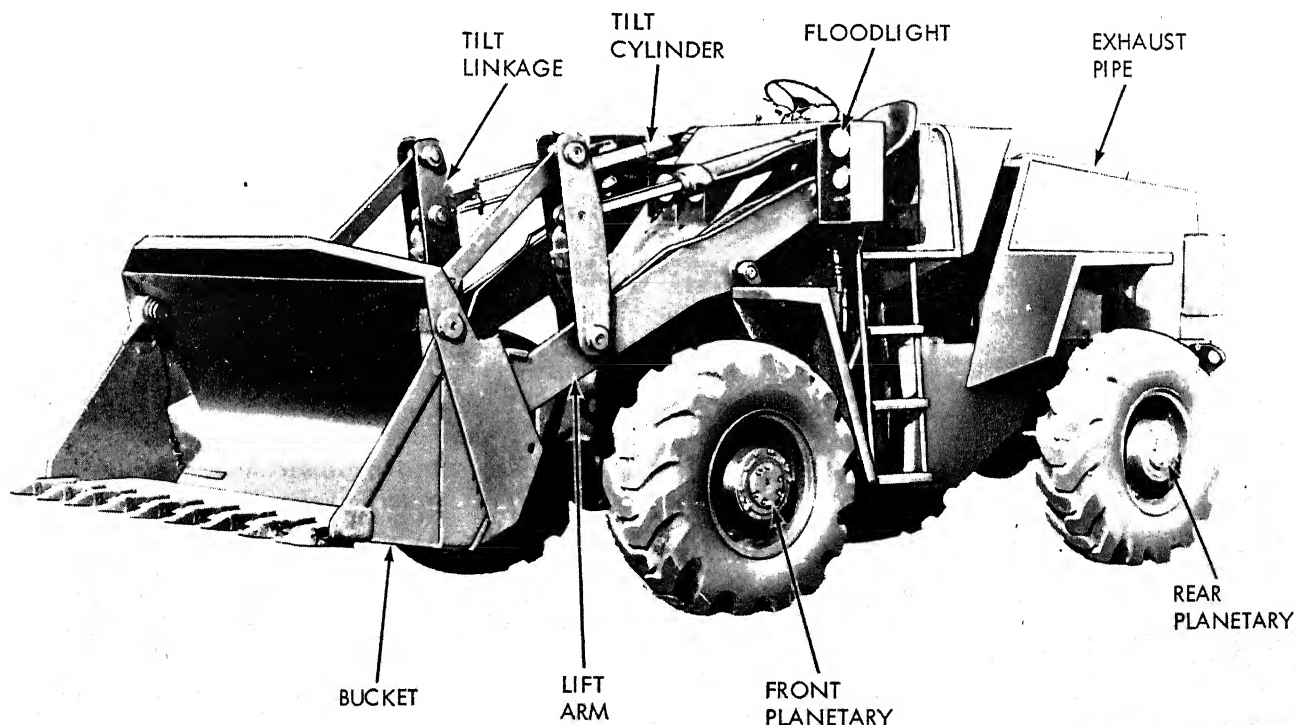
Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, Recommended Changes Publications, and forwarded to U.S. Army Mobility Command, ATTN: AMSME-MPP, 4300 Goodfellow Blvd., St. Louis, Mo. 63120.

### Section II. DESCRIPTION AND DATA

#### 1-5. Description

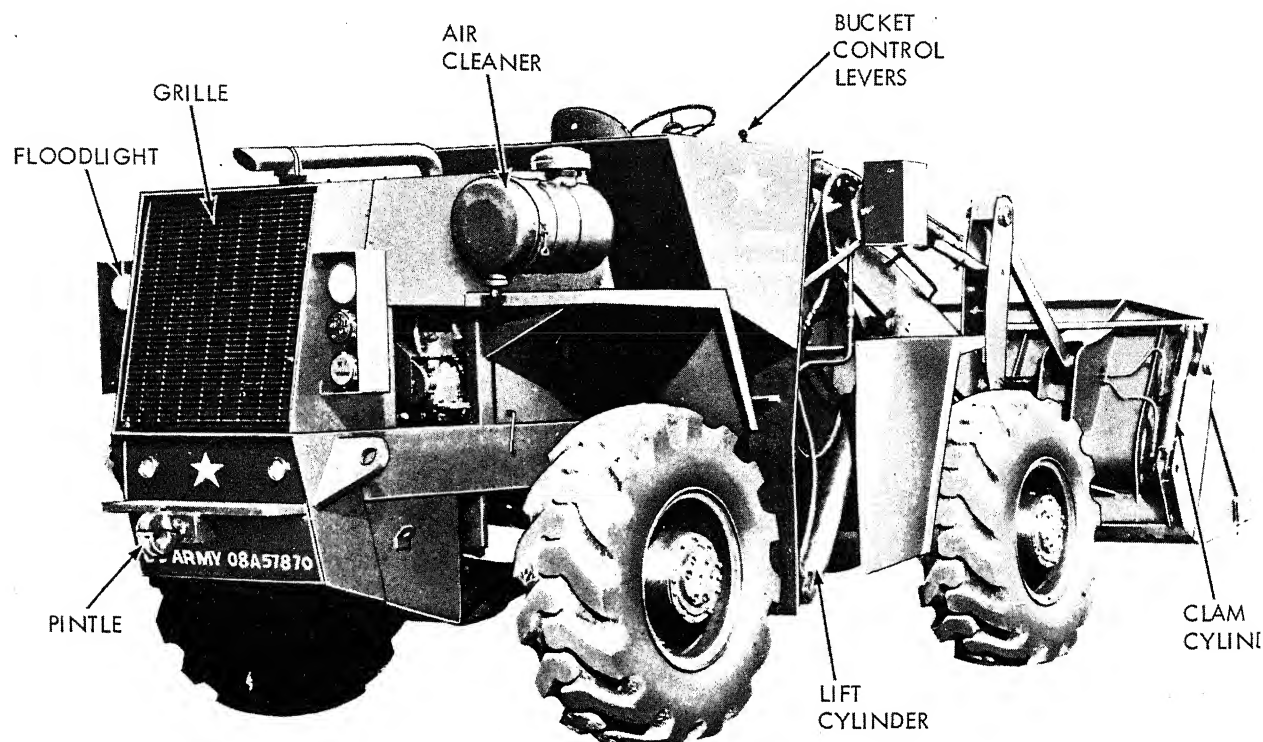
a. *General.* The MW24 Scoop Loader (fig. 1-1 and 1-2) is built by J.I. Case Co. It is rubber-tired

and has articulated steering, four wheel drive and a multi-purpose bucket.



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Figure 1-1. Loader, scoop, left front, three quarter view.



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Figure 1-2. Loader, scoop, right rear, three quarter view.

**b. Engine.** The loader, powered by Diesel engine, develops 360 pound-feet of torque at 1400 rpm. The engine is located above the rear axle, behind the operator's compartment.

**c. Transmission and Drive Lines.**

(1) **Transmission.** The powershift transmission has four forward and two reverse speeds. It has single lever control and shifts from first low to second low and first high to second high automatically.

(2) **Torque converter.** The twin turbine integral with transmission torque converter has a 5.1 to 1 stall ratio.

(3) **Axles.** Front and rear drive axles provide four wheel drive. The rear axle oscillates up or down 11 1/2 degrees.

**d. Steering.** The loader is articulated with steering control provided by a tandem-type hydraulic pump and mechanical follow-up linkage.

**e. Bucket and Controls.** The loader is equipped with a 2 1/2 cubic yard multi-purpose bucket which can be used as a clam bucket or for scraping or bulldozing. The tandem hydraulic pump provides the power to operate the lift, tilt and clam cylinders.

## 1-6. Differences between Models

The MW24 Scoop Loader is the only model issued to the effective publication date of this manual. No known difference exists within the model.

## 1-7. Identification and Tabulated Data

**a. Identification.** The loader has eight major identification plates.

(1) The Army data plate is located on the right side of the interior of the operator's compartment. It gives the model, stock, contract, registration and serial numbers as well as dimensional criteria and shipping weight.

(2) The transportation data plate, located on the right front fender, gives shipping information.

(3) The master maintenance plate, located on the left front fender, gives maintenance lubrication instructions.

(4) Two safety plates located on the front of the right rear frame provide precautionary information pertinent to the safety of personnel.

(5) The fuel injection pump plate is located on the right side of the pump and gives model and serial numbers.

**Make** ..... Robert Bosch Corp  
**Model** ..... EP / RSV375-1100A2B  
**Setting** ..... 2200 rpm

(8) *Starter.*

Type .....	Heavy duty (250)
Capacity .....	24 volts
Make .....	Delco-Remy
Model .....	1113949

(9) *Turbocharger.*

Type .....	Fixed orifice
Make .....	Garret Corp
Model .....	408310-2
Boost ratio .....	2.3:1 at rated rpm
Maximum recommended turbine speed .....	140,000 rpm

(10) *Radiator.*

Type .....	Heavy duty fin and tube
Capacity .....	48 quarts
Make .....	General

(11) *Fan.*

Type .....	Blower
Diameter .....	22 inches
Number of blades .....	6

(12) *Water pump.*

Type .....	Centrifugal vane
Make .....	J.I. Case
Model .....	A58641
Drive .....	Belt
Rating .....	100 gpm at 2200 engine rpm
Speed as installed .....	2550 rpm

(13) *Thermostat.*

Type .....	Metal expansion
Make .....	Robert Shaw-Fulton
Model .....	I-1700-A2
Temperature rating .....	Open 202°F
	Closed 179°F

(14) *Transmission.*

Type .....	Powershift
Make .....	Allison
Model .....	TT-2420-1
Lubricant capacity .....	40 quarts
Speed range:	

<b>Forward</b>	
1st .....	0 to 2.7 mph
2nd .....	0 to 6.1 mph
3rd .....	0 to 11.5 mph
4th .....	0 to 23.0 mph
<b>Reverse</b>	
1st .....	0 to 3.7 mph
2nd .....	0 to 8.3 mph

(15) *Torque converter.*

**Make** ..... **Allison**

## Type ..... Centrifugal

### General Torques

Bolt Size (inches)	Grade 5		Grade 8	
	Dry	Lubricated (pound-feet)	Dry	Lubricated (pound-feet)
1/4	8-10	6-7	12-14	9-10
5 / 16	17-19	13-14	24-26	18-20
3/8	30-35	23-25	45-50	34-36
7 / 16	50-55	35-40	70-80	55-60
1/2	75-90	55-65	110-120	80-90
9 / 16	110-120	80-90	150-170	110-130
5/8	150-180	110-130	220-240	170-180
3/4	260-300	200-220	380-420	280-320
7 / 8	400-440	300-320	600-660	460-500
1	580-640	440-480	900-1000	680-740
1 1/8	800-880	600-660	1280-1440	960-1080
1 1/4	1120-1240	840-920	1820-2000	1360-1500
1 3/8	1460-1680	1100-1260	2380-2720	1780-2040
1 1/2	1940-2200	1460-1640	3160-3560	2360-2660

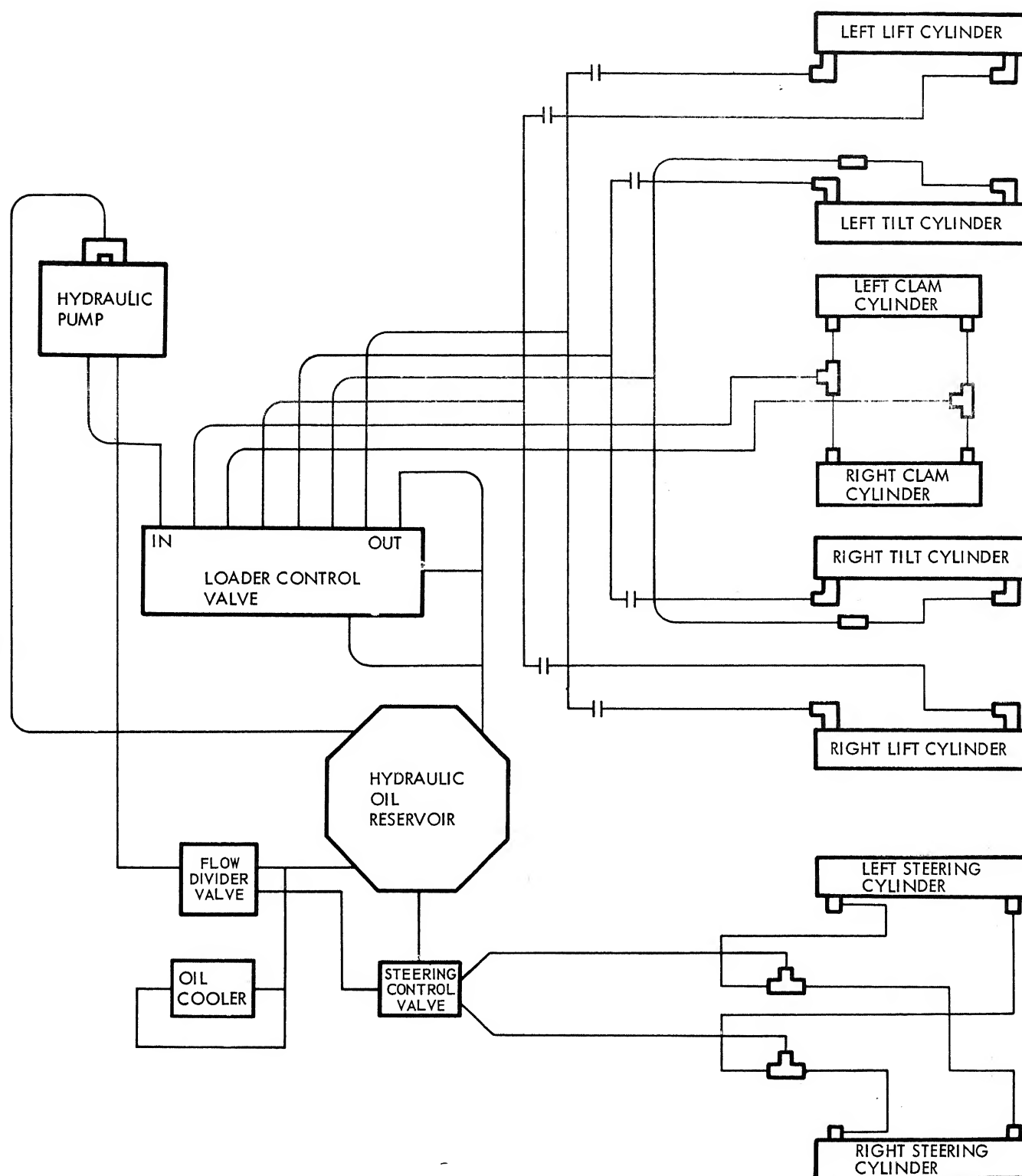
Note. These values apply to fasteners as received from supplier, dry, or when lubricated with normal engine oil. They do not apply if special graph or molybdenum disulphide greases or other extreme pressure lubricants are used. This applies to both UNF and UNC threads.

(39) *Wiring diagram.* See figure 1-3

*Figure 1-3. Wiring diagram.*

(Located in back of manual)

(40) Hydraulic diagram. See figure 1-4.

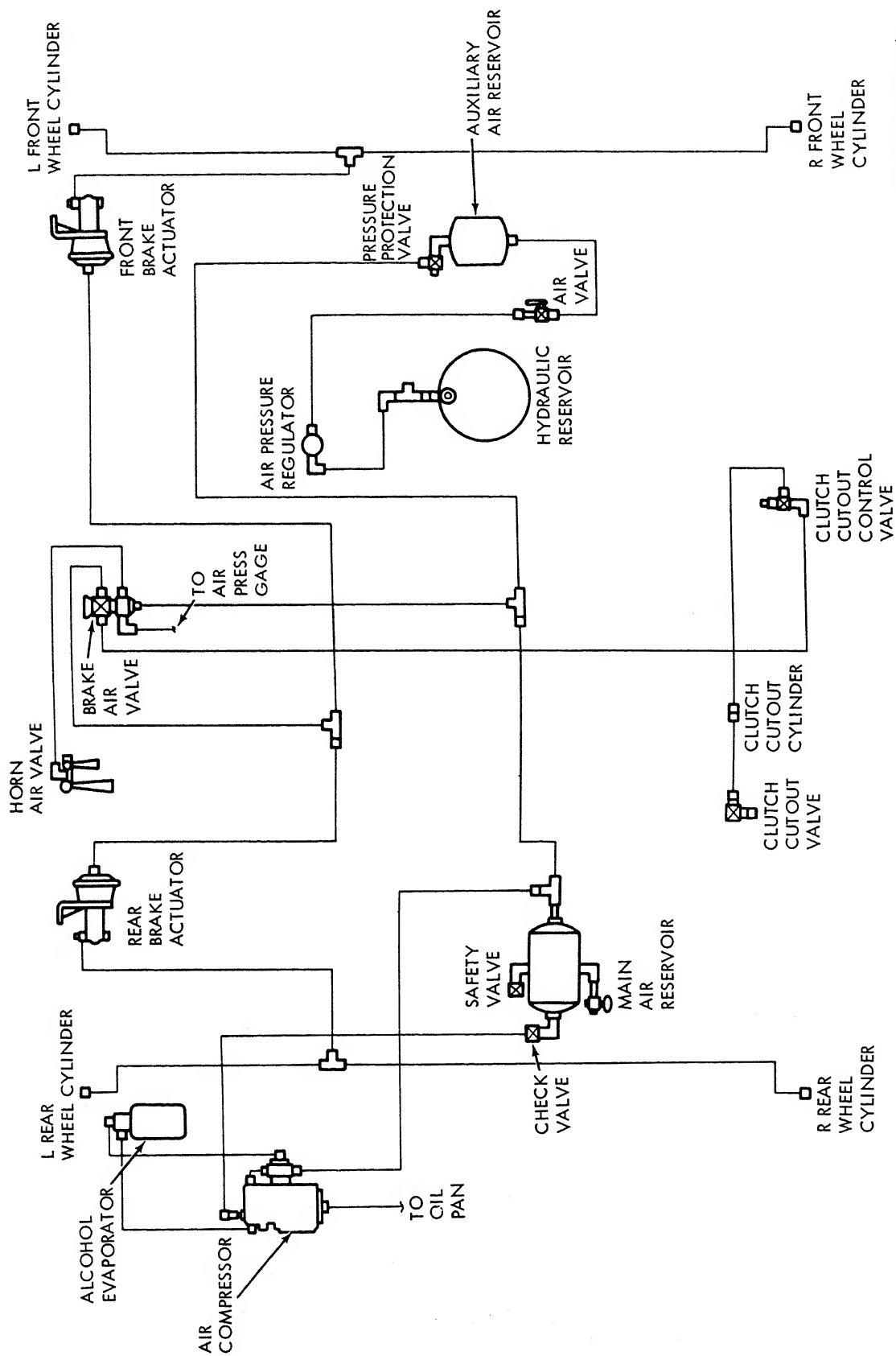


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Figure 1-4. Hydraulic diagram.

(41) *Air system schematic diagram. See figure 1-5.*

1-8



ME 3805-250-14/1-5

Figure 1-5. Air system schematic diagram.

## CHAPTER 2

### OPERATING INSTRUCTIONS

#### Section I. SERVICE UPON RECEIPT OF MATERIAL

##### 1. Inspecting and Servicing the Equipment

- a. Inspect identification plates and receipt indices to ensure receipt of proper equipment.
- b. Inspect loader body, frame, and all external parts for loss or damage that may have occurred during shipment.
- c. Inspect all hydraulic lines for leaks or loose fittings.
- d. Inspect electrical wiring for frayed insulation and broken connections.
- e. Check and tighten as necessary all accessible

nuts, bolts and other attaching hardware. Refer to paragraph 1-7 for torque data.

f. Check engine cooling system for leaks and for proper coolant mixture. Correct coolant level is within one inch of the top of the radiator. Refer to TB 750-651 for cooling system maintenance instructions.

g. Perform daily maintenance checks and services as described in paragraph 3-5.

##### 2-2. Installation

Before operation, position safety link in the stowed position. (fig. 2-1.)



Figure 2-1. Safety link.



## Section II. MOVEMENT TO A NEW WORKSITE

### 2-3. General

The loader does not require dismantling before moving to a new worksite. This section describes methods of transporting the loader.

### 2-4. Driving

Movement of the loader to a new worksite can be accomplished by moving the loader over the road under its own power. Since the loader is wider than most vehicles, care should be taken to provide clearance for other traffic when traveling on public roads.

### 2-5. Towing or Pushing

a. When towing or pushing the loader for distances less than  $\frac{1}{2}$  mile, the drive lines may be left connected if the loader is transported at low speed.

b. When towing or pushing the loader for distances greater than  $\frac{1}{2}$  mile or at high speed, refer to organizational maintenance personnel to

disconnect the drive line shafts.

**CAUTION:** Seal the exhaust pipe to prevent autorotation of the turbocharger caused by wind velocity.

### 2-6. Shipping

Long distance moving of the loader should be accomplished with suitable transportation equipment such as a flat bed truck trailer or a railroad car. Tiedown and block the loader securely and perform the following operations.

a. Install the safety locking bar (fig. 2-1).

b. Install protective covers on the air cleaner intake, fuel filler cap, breathers, alternator, alternator regulator, hydraulic fill cap and hydraulic cylinder rods.

c. Place a tag on the steering wheel indicating that the above services have been performed and instructing the operator to remove the protective covers and safety bar.

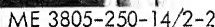
## Section III. CONTROLS AND INSTRUMENTS

### 2-7. General

This section describes the various controls and instruments and provides the operator/crew necessary information to properly operate the loader.

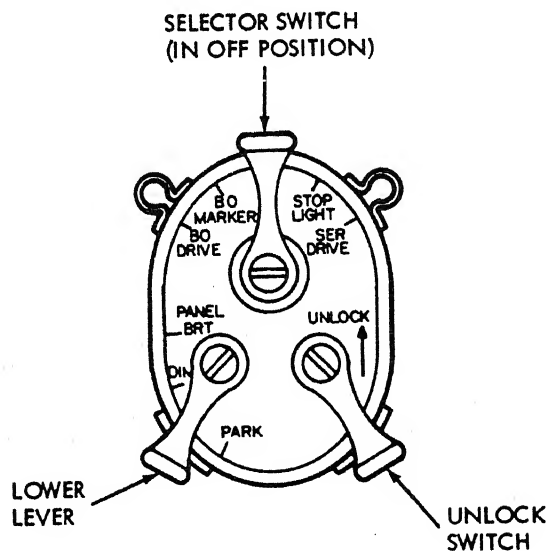
### 2-8. Controls and Instruments

Refer to figures 2-2 through 2-6 for the location and description of all controls and instruments.



**CLUTCH PRESSURE GAGE.** Indicates the hydraulic clutch oil pressure. Normal operating pressure is 145 to

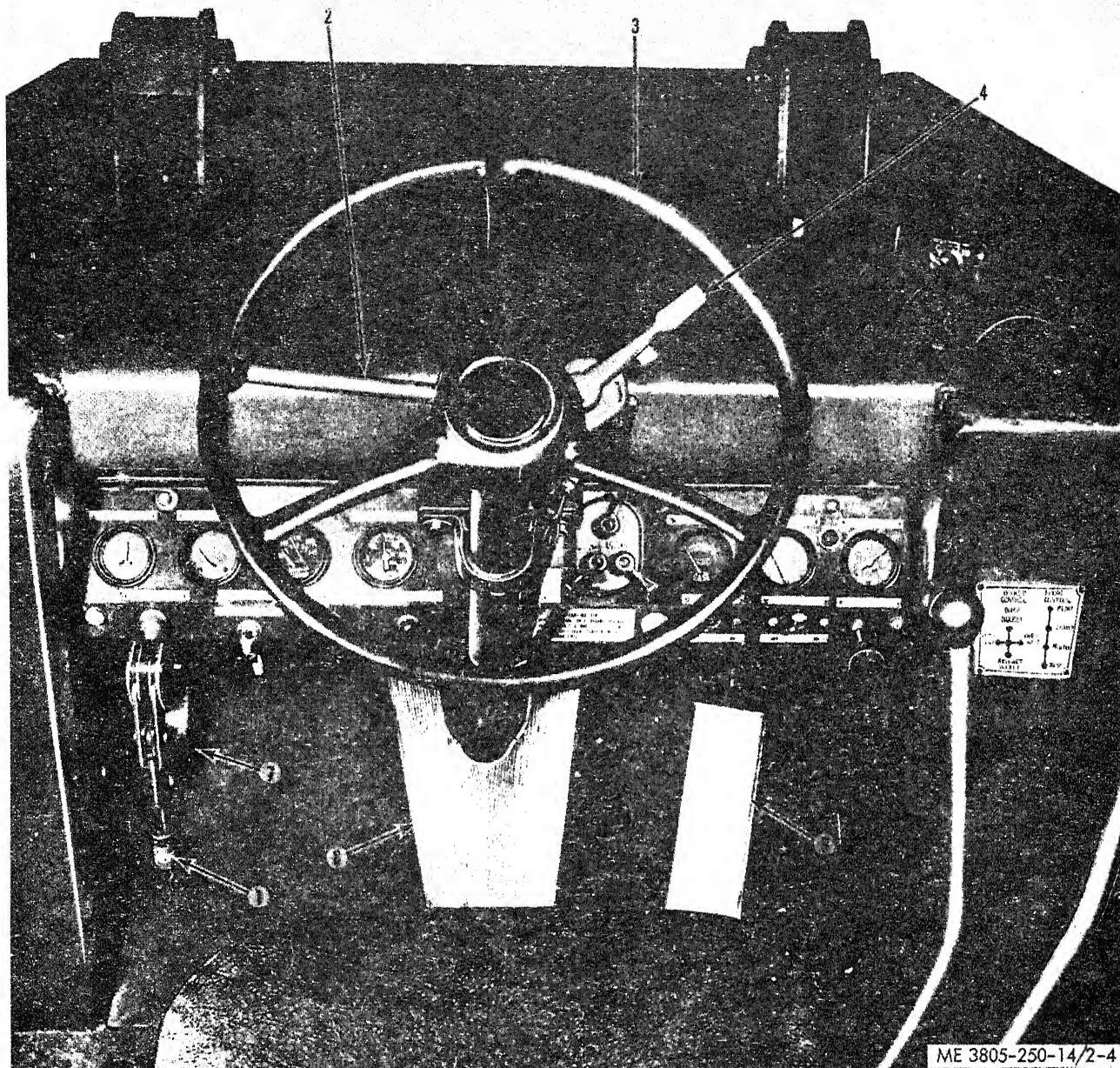
17. **HORN BUTTON.** A push button switch that activates the horn.



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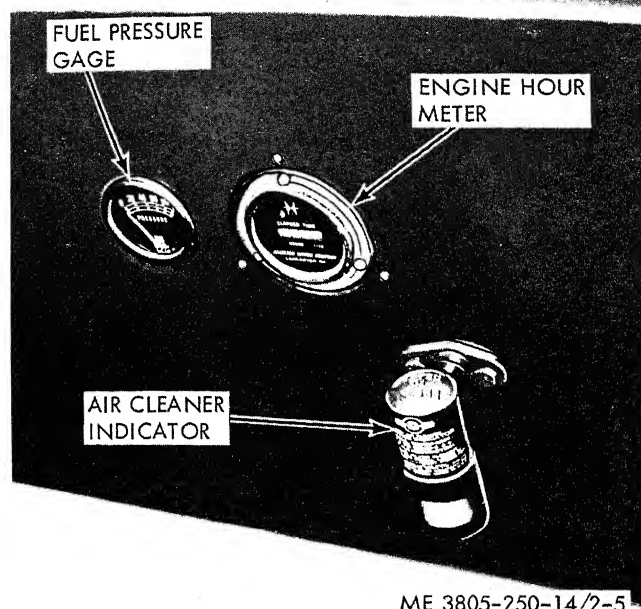
1. Place selector switch in "BO DRIVE" to operate blackout head and taillights for blackout driving.
  2. Place selector switch in "BO MARKER" for parking lights operation in blackout conditions.
  3. Place selector switch in off position to deactivate all vehicle lights.
  4. Place selector switch in "STOP LIGHT" to operate vehicle stop lights, turn signal lights, parking and panel lights.
  5. Place selector switch in "SER DRIVE" to operate vehicle head and taillights, signal lights, and floodlights.
- Note.* To place selector switch in "SER DRIVE" lift unlock switch to unlock position.
6. Place lower lever in positions indicated to operate panel lights and parking lights.

Figure 2-3. Master light switch.



1. **PARKING BRAKE LEVER.** Raise lever to set the parking brake.
2. **TRANSMISSION CONTROL LEVER.** Controls operation of the transmission. Lever has four positions. Move lever forward to first detent to operate loader forward in low range. Move lever all the way forward to operate loader forward in high range. Move lever all the way to the rear to operate in reverse. Place lever in center for neutral.
3. **STEERING WHEEL.** Controls turning of the loader.
4. **TURN SIGNAL SWITCH.** Push lever upward to operate left turn signal lights. Pull lever down to operate right turn signal lights.
5. **ACCELERATOR.** Controls engine speed. Depress pedal to increase speed, release pedal to decrease speed.
6. **BRAKE PEDAL.** Depress pedal to activate vehicle wheel brakes and stop lights.
7. **BUCKET KICKOUT CONTROL LEVER.** Automatically controls bucket height. Set the control lever in a 7, 8 or 9 foot kickout position. When the bucket reaches the selected height, the bucket control lever automatically returns to neutral.

*Figure 2-4. Operator's compartment controls.*



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1. **FUEL PRESSURE GAGE.** Indicates condition of the fuel filters. When the gage needle drops to 20 psi, the filters must be replaced.
2. **HOURLMETER.** Records average engine operating time at an average engine rpm in hours and tenths of hours.
3. **AIR CLEANER SERVICE INDICATOR.** When the red signal appears in full view, the air cleaner must be serviced immediately. To reset, push reset button in and release. A green signal indicates the air cleaner is properly serviced.

*Figure 2-5. Hood-mounted instruments.*

## **Section IV. OPERATION UNDER USUAL CONDITIONS**

### **2-9. General**

a. The instructions in this section are for the information and guidance of personnel who operate the loader.

b. The operator must know how to perform every operation the loader is able to execute. This section contains instructions on starting and stopping the loader, on operating the loader, and on coordinating the basic motions to perform the specific work tasks. Since nearly every job presents a

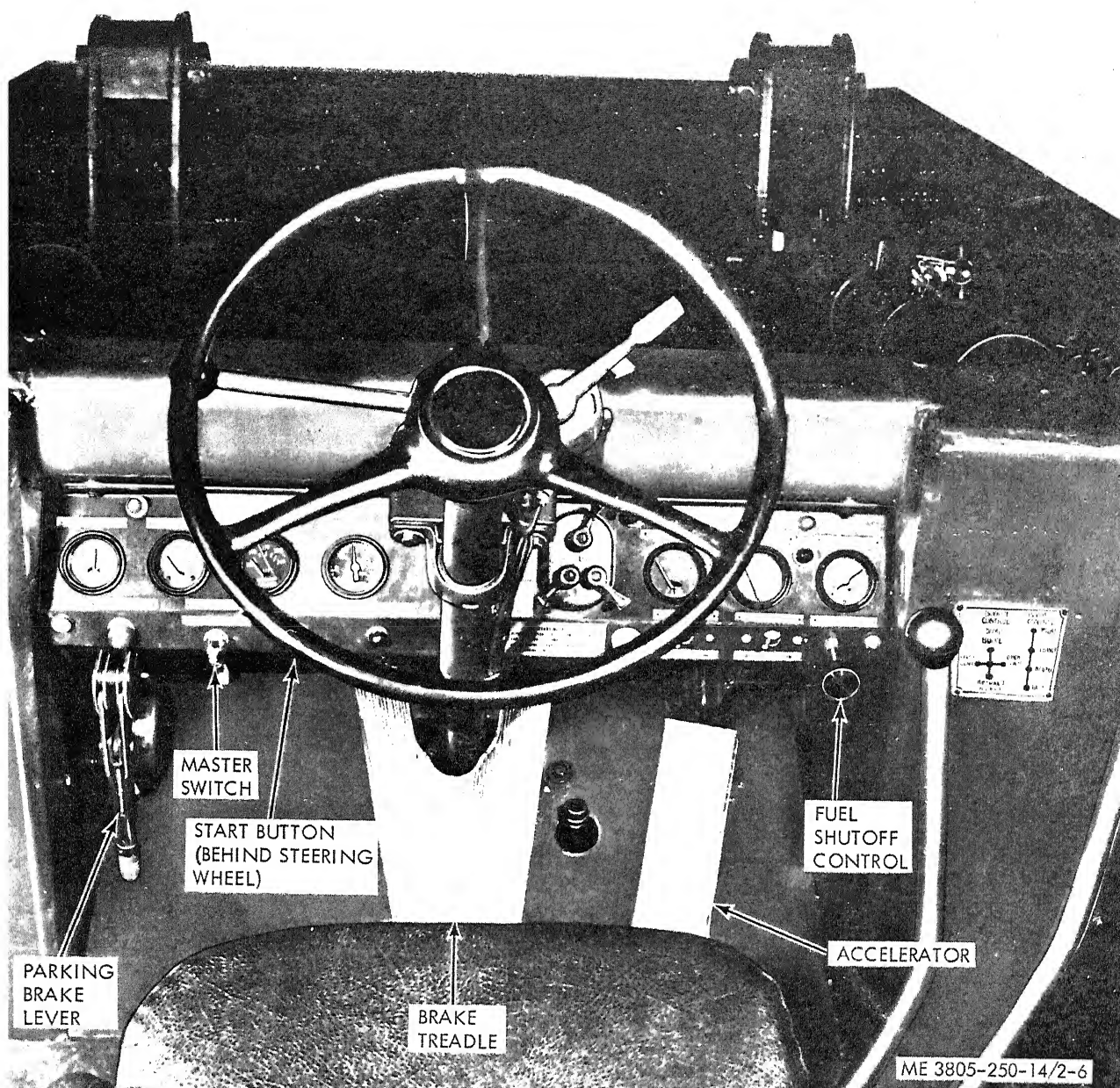
different problem, the operator may have to vary given procedures to fit each job.

### **2-10. Starting**

Before starting the loader refer to paragraph 3-5 and perform the required daily preventive maintenance services. Refer to figure 2-6 for starting instructions.

**CAUTION:** Do not push or tow loader to start.





#### **STARTING**

**Note:** Before starting the engine, ensure that all control levers are in neutral position.

- EP 1. Push fuel shutoff control lever all the way in the instrument panel.
- EP 2. Turn master switch to "ON."
- EP 3. Depress accelerator half way down.
- EP 4. Depress start button.

**Caution:** If engine fails to start after 30 seconds of starting motor engagement, wait at least 2 minutes before re-engaging starter for another attempt to start.

- EP 5. Once started, let the engine idle until it reaches operating temperature.

- STEP 6. Check all controls and instruments to ensure proper operation of the loader.

- STEP 7. Release the parking brake before attempting to move the loader.

#### **STOPPING**

- STEP 1. Release accelerator and depress the brake treadle to stop the motion of the loader.

- STEP 2. Place all control levers in neutral and allow the engine to idle for a few minutes so that the engine parts can cool evenly.

- STEP 3. Set the parking brake by raising the brake lever upward.

- STEP 4. Pull the fuel shutoff lever out to stop the fuel flow.

- STEP 5. Turn the master switch to "OFF."

Figure 2-6. Loader starting and stopping procedures.

### 2-11. Stopping

a. Before shutting down the engine, steer the loader so that the front and rear sections are aligned.

**WARNING: To prevent possible injury or death to personnel, always lower bucket to ground before leaving loader unattended.**

b. Follow procedures described in figure 2-6 and stop the loader.

c. Perform required daily preventive maintenance services as stated in paragraph 3-5.

### 2-12. Operation of Equipment

#### a. *Placing Loader in Motion.*

(1) Start the loader (para. 2-10) and allow the engine to reach operating temperature.

(2) Raise the bucket about one foot from the ground. Refer to figure 2-7 for bucket operation.

(3) Release the parking brake and place the transmission control lever in the proper position for the desired direction and range.

(4) Depress the accelerator (fig. 2-4) to start the loader in motion. Regulate speed by altering pressure on the accelerator.

KEY to fig. 2-7:

#### BOOM ARM OPERATION

1. To float bucket, move the boom control lever to "FLOAT."
2. To lower bucket, move the boom control lever to "LOWER."
3. To raise bucket, hold the boom control lever in "RAISE" or lock in "RAISE" and use the bucket kickout control (fig. 2-4).

#### BUCKET OPERATION

1. To dump bucket, move the bucket control lever forward to "DUMP BUCKET." The lever will return to neutral when released.
2. To retract bucket, move the bucket control lever to "RETRACT BUCKET" detent. The bucket will automatically return to a level or dig position and the bucket control lever to neutral.
3. To open clam, move the bucket control lever to "OPEN CLAM."
4. To close clam, move the bucket control lever to "CLOSE CLAM."

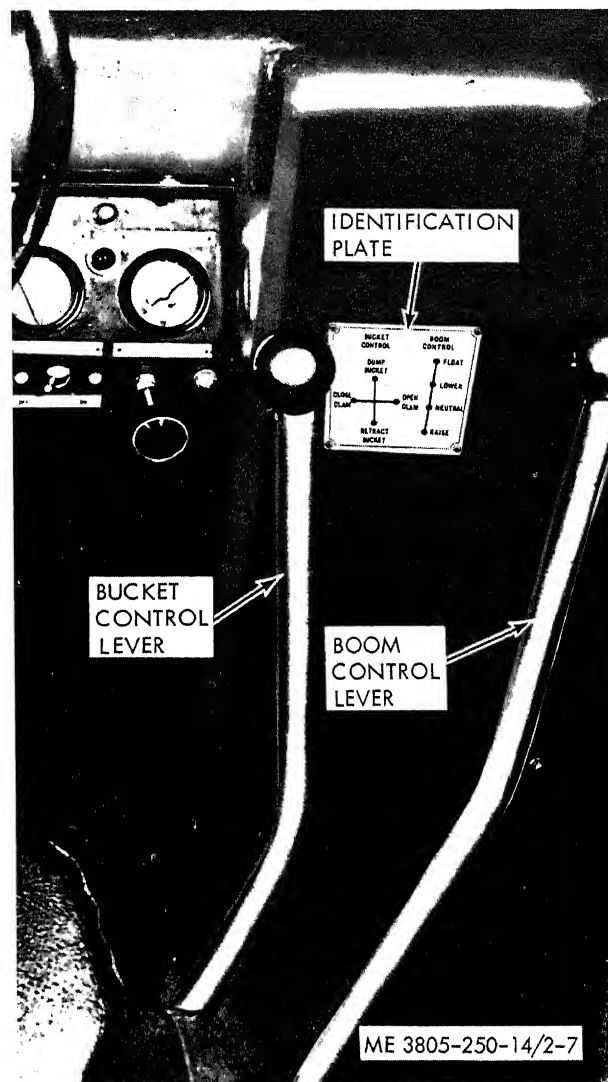


Figure 2-7. Bucket control levers operation.



*b. Shifting Transmission while in Motion.*

(1) The transmission can be shifted from low to high while the loader is in motion and at full throttle.

**CAUTION: Do not downshift from high range to low range at speeds above 5 mph.**

(2) To change direction (forward to reverse or reverse to forward) release the accelerator and stop the loader before moving the transmission control lever.

(3) Always operate the loader in a speed range that will require full speed operation of the engine.

*c. Steering.* Steer the loader by turning the steerwheel in the direction of the turn desired. Hydraulic cylinders pivot the front end of the loader in the direction of turn. Hold the steering wheel in position until the turn is completed. To align the front and rear sections after completing a turn, rotate the steering wheel in the opposite direction until the sections are in line.

*d. Bucket Operation.*

(1) *General.* The multi-purpose bucket consists of a mold board, a pivoted clam, and two hydraulic cylinders which operate the clam. Bucket operation is controlled by the bucket control lever and the boom control lever (fig. 2-7).

**CAUTION: Never attempt to operate the bucket before the engine reaches operating temperature.**

(2) *Normal loader operation.* (fig. 2-8).

(a) Place the kickout control lever in the desired height position.

(b) Move the bucket control lever "CLOSE CLAM."

(c) Raise the bucket by pulling the boom control lever to "RAISE."

(d) Drive the loader to the material to be loaded.

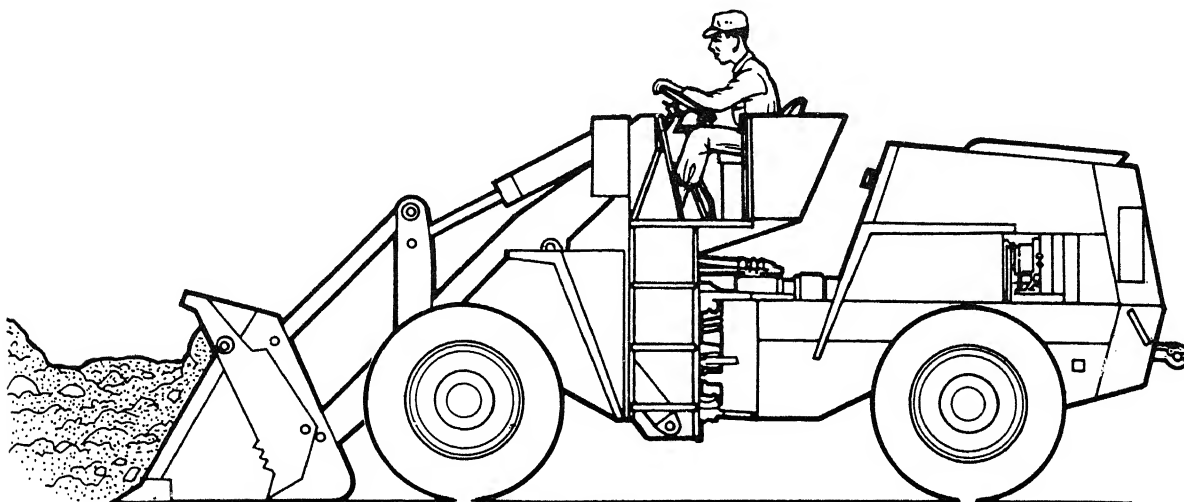
(e) Push the boom control lever "LOWER" to lower the bucket, then place lever in "NEUTRAL."

(f) Adjust the bucket angle for most efficient loading.

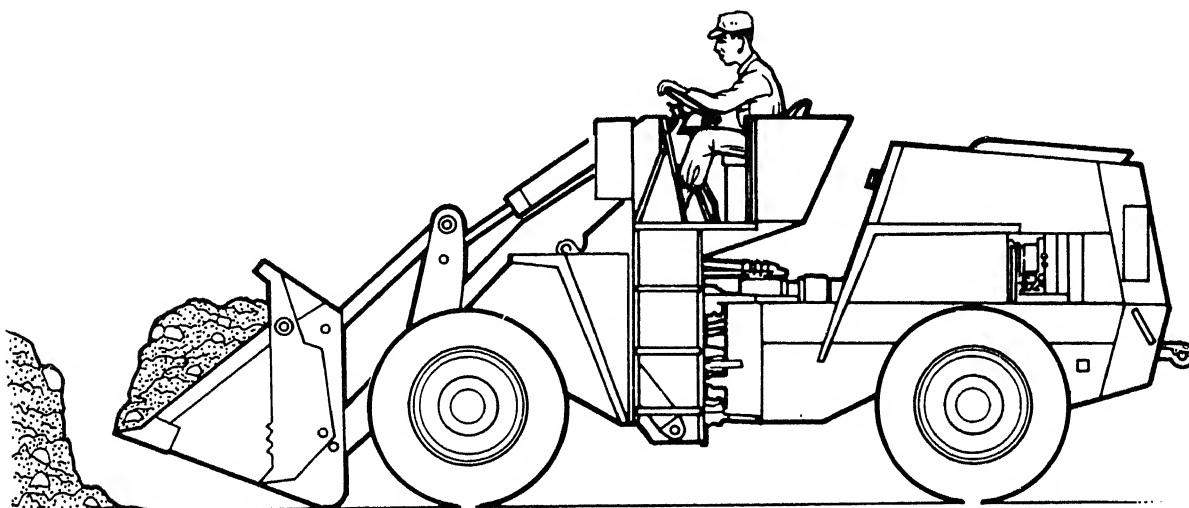
(g) With the transmission in low gear and the accelerator full depressed, drive the loader into the material. Move the boom control lever toward "RAISE" as the bucket enters the material and bucket control lever toward "RETRACT BUCKET" as the bucket fills.

*Note.* If the loader begins to stall, touch the kickout pedal lightly and move the bucket control lever to "RETRACT BUCKET."

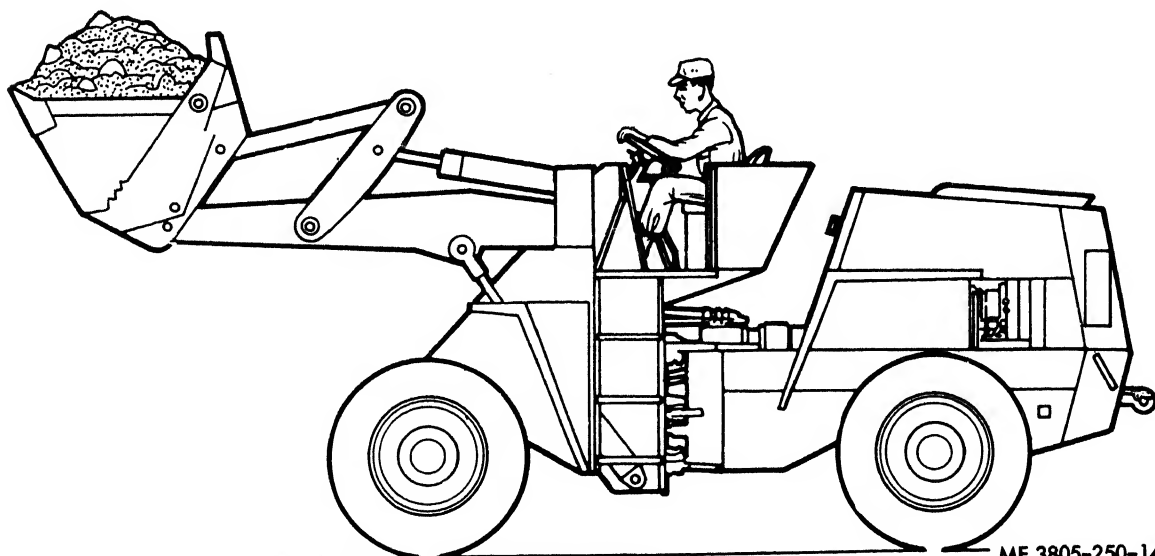
(h) Place the transmission in reverse, and back the loader from the material.



APPROACH



LOADING BUCKET



BUCKET LOADED

ME 3805-250-14/2-8

Figure 2-8. Loading bucket.

(i) Drive the loader to the dumping area. If a truck is to be loaded, raise the bucket to clear the side of the truck. As the bucket moves over the truck body, move the bucket control lever toward "DUMP BUCKET" and pull the boom control lever toward "RAISE." Continue to move the loader forward until the bucket is empty.

(j) Pull the bucket control lever to "RETRACT BUCKET." Back loader away from the dumping area.

(k) Place the boom control lever in "FLOAT" to lower bucket.

(3) *Loading hard material.*

(a) Approach the material with the bucket positioned as described in subparagraph (2) above.

(b) As the bucket penetrates the material, place the boom control lever in "FLOAT." Move the bucket control lever back and forth between "DUMP BUCKET" and "RETRACT BUCKET" to agitate the bucket while moving the loader forward.

(c) As the bucket loosens the material, move the boom control lever toward "RAISE." As the bucket fills, move the bucket control lever toward "RETRACT BUCKET."

(d) When the bucket is filled, retract the bucket and transport the material to the dumping area.

(4) *Truck loading.*

(a) When truck loading from a stockpile, park the truck at 90° to the pile with the body of the truck toward the pile.

(b) Approach the pile with the loader at 45° to the pile and the truck. When the bucket is 10 to 12 feet from the side of the truck, turn the loader into the pile and load the bucket.

(c) With the bucket loaded, back the loader from the pile at the same angle as entry. When the bucket clears the pile, apply the brakes, shift to low forward speed, and move forward while turning the loader toward the truck. Dump the load as described in step (2) above.

(d) Keep the truck and loader as close together as possible.

(5) *Transporting load.*

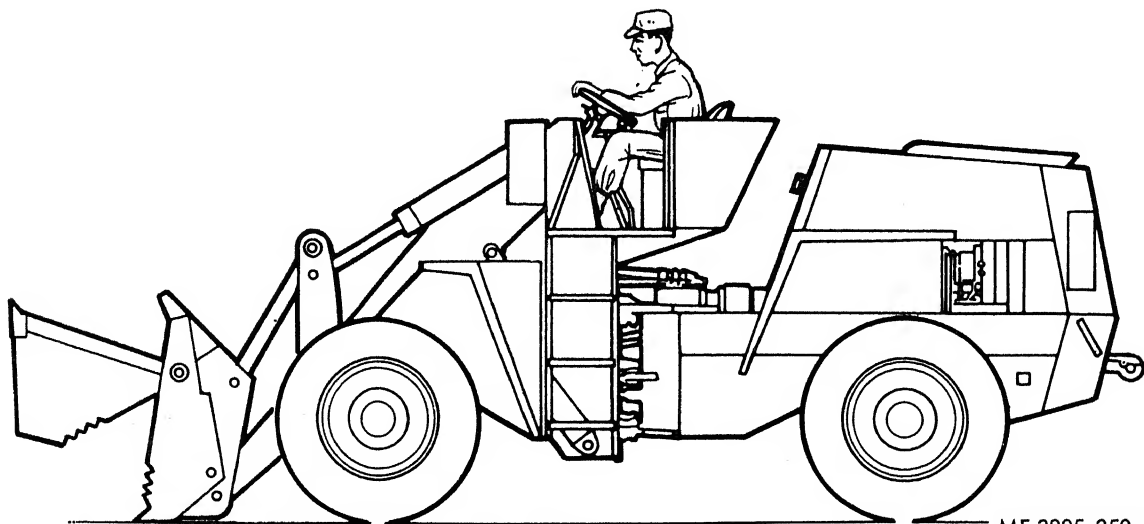
(a) Carry the bucket close to the ground when transporting a load.

(b) Keep the bucket tipped back to prevent spillage.

e. *Bulldozing.*

(1) *Operation.*

(a) Move the boom control lever to "LOWER" and position the bucket on the ground. Move the bucket control lever to "OPEN CLAM" to position bucket as shown in figure 2-9.



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Figure 2-9. Clam positioned for bulldozing operation.

(b) Move the loader forward, pushing material with the bucket. A trench is usually formed from material spilled on either side of the bucket. If possible, work the loader in the trench for maximum loads.

(c) When removing brush and small trees, lower the cutting edge far enough into the ground to strike and cut the roots.

(d) When removing heavier trees, raise the bucket to a higher position for leverage and push the tree to the ground. Lower the bucket to the ground and cut the roots.

(2) *Bucket adjustment.*

(a) The digging angle of the bucket

moldboard can be increased by tilting the bucket forward. Push the control lever toward "BUCKET DUMP" for deeper digging.

(b) The digging angle of the bucket moldboard can be decreased by moving the bucket control lever toward "RETRACT BUCKET."

f. *Scraping.*

(1) *Operation.*

(a) Move the boom control lever toward "LOWER" to position the bucket on the ground. Move the bucket control lever toward "OPEN CLAM" to position the bucket as shown in figure 2-10.

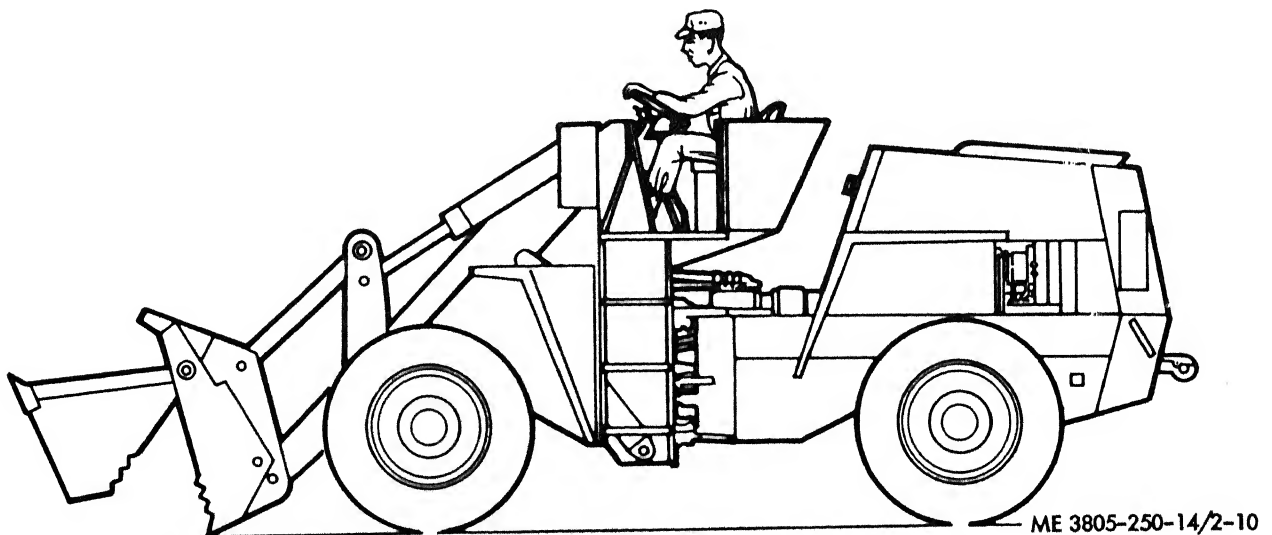


Figure 2-10. Clam positioned for scraping operation.

(b) Operate the loader as a scraper by placing the vehicle in motion. A two inch scraper cut will be obtained in the position shown.

(2) *Scraper adjustment.*

(a) If a deeper scraper cut is required, lower the bucket.

(b) If a smaller scraper cut is required, raise the bucket.

g. *Clam Shell Operation.*

(1) Move the boom control lever to raise the bucket off the ground. Move the bucket control lever to position the clam in the fully open position as shown in figure 2-11.

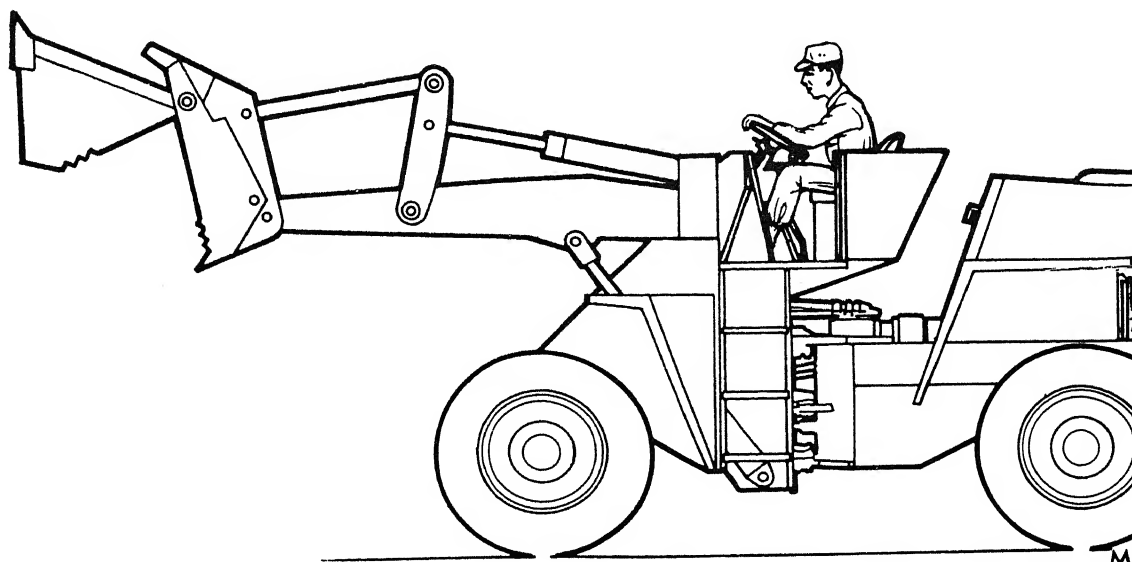


Figure 2-11. Clam fully open.

(2) Operate the boom control lever to raise the bucket high enough to suspend over the material to be loaded.

(3) With the clam open, move the boom control lever toward "LOWER" to lower the bucket into the material.

(4) Move the bucket control lever toward "CLAM" and fill the bucket.

(5) Move the boom control lever toward "UP" and clear the material.

(6) Move the loader to the material. Move the bucket control lever toward "RELEASE" and release the material.

## Section V. OPERATION UNDER UNUSUAL CONDITIONS

### 2-13. Operation in Extreme Cold

*a. General.* If the loader is to be operated in extreme cold weather temperatures, certain precautions must be taken to ensure continued normal operation.

*b. Cooling System.* Check the cooling system for the correct antifreeze solution for the temperature (para 2-1). Inspect the cooling system for leaks.

*c. Batteries.* Keep the batteries fully charged to prevent freezing. When water is added to the batteries, run the engine at least one hour to mix the electrolyte solution.

*d. Fuel System.* Fill the fuel tank after operation. Drain condensation from the tank before and after operation. Drain and service the fuel filter often.

*e. Lubrication.* Thoroughly lubricate the loader according to the current Lubrication Order.

*f. Operation.*

(1) Start the engine and allow it to reach normal operating temperature before applying load.

(2) If mud or snow collects and freezes on any of the loader moving parts while the engine is

idling, thaw the frozen parts before operate the loader.

(3) Operate the hydraulic unloading lever until they have warmed up.

(4) Check all operations to ensure operating normally.

*g. Parking.*

(1) Park the loader on high ground. Prepare a footing of planks or bricks to keep the wheels from freezing to the ground. Release the parking blocks under the bucket to prevent damage to the ground.

(2) Clean all mud, snow, and ice from the bucket. Place the loader under a tarpaulin. Keep the tarpaulin from freezing to the ground.

### 2-14. Operation in Extreme Heat

*a. General.* Continuous operation at high temperatures may cause engine overheating. Avoid continuous low speed operation as much as possible. Observe engine and

peratures and allow the loader to cool off whenever necessary.

*b. Cooling System.*

(1) Inspect and service the fan and radiator frequently. Keep the coolant level one inch from the top of the radiator. Check the radiator fins for an accumulation of dust, sand, and insects which could block the cooling passages.

(2) Change coolant each year to keep the corrosion inhibitor at full strength.

(3) If necessary, flush the cooling system periodically to keep passages clear. Do not use water with a high alkali content.

*c. Batteries.* Check the level of electrolyte daily. Keep the electrolyte above the plates to prevent damage to the batteries. Use a slightly weaker electrolyte in hot climates. Dilute 1.280 specific gravity electrolyte as issued to 1.200 to 1.240 specific gravity reading at full charge. Recharge batteries when the specific gravity drops to 1.160.

*Note.* Batteries discharge at a higher rate if left standing for long periods at high temperatures. If the loader is to stand for several days, remove the batteries and store in a cool place.

*d. Fuel System.* Service the fuel system. Check fuel for water content before filling the tank. Condensation could be formed in the fuel tank or storage drums.

*e. Lubrication.* Lubricate as instructed in the current Lubrication Order.

*f. Parking.*

(1) Do not park the loader in the sun for long periods. Park under cover whenever possible or cover with tarpaulins. Protect the engine, transmission and hydraulic pumps from sand and dirt.

(2) In hot, damp climates, protect unfinished exposed metal surfaces with a film of preservative lubricating oil, medium. Protect cables and terminals with ignition-insulation component. Apply paint or rust preventive to damaged surfaces to protect from rust and corrosion.

**2-15. Operation in Dusty or Sandy Areas**

*a. General.* Operation of the loader may cause dust in almost any area. However, when operating in predominately dusty or sandy areas, additional precautions must be taken.

*b. Cooling System.* Keep radiator fins and passages clean. Blow out with compressed air as often as necessary.

*c. Fuel System.* Prevent dust and sand from entering the fuel tank or filters when servicing the fuel system.

*d. Air System.* Service the air cleaner frequently, check the air restriction indicator daily, and keep the dust valve clean. Prevent dust and sand from entering the engine parts as much as possible.

*e. Lubrication.* Lubricate the loader according to the current Lubrication Order. Lubricate and service more frequently than normal. Clean fittings before lubricating.

*f. Parking.* Protect loader from dust and sand by parking under cover or covering with tarpaulins.

**2-16. Operation under Rainy or Humid Conditions**

*a. General.* Operation under rainy or humid conditions is similar to operation in extreme heat.

*b. Preservation.* Keep all exposed surfaces coated with a medium preservative lubricating oil. Cover all paint cracks and marks to prevent corrosion.

**2-17. Operation in Salt Water Areas**

*a. General.* Salt water and salt water spray can cause extensive corrosive damage to the loader.

*b. Preservation.* When exposed to salt water, dry thoroughly and rinse with fresh water as soon as possible. Coat exposed surfaces with medium preservative lubricating oil.

*c. Lubrication.* Lubricate loader as prescribed in the current Lubrication Order. Lubricate areas subject to salt water more frequently.

**2-18. Operation at High Altitudes**

*a. General.* Normally, operation of the loader at high altitudes will be the same as operation in extreme cold. Before operating the engine at altitudes above 8000 feet, adjust the fuel injection pump to reduce the engine fuel input. This will prevent over-speeding the turbocharger and will maintain exhaust temperatures within permissible limits. Refer to paragraph 6-2.

*b. Cooling System.* Check for overheating. Check the radiator cap for a good seal.

## Section VI. OPERATION OF MATERIAL USED IN CONJUNCTION WITH THE EQUIPMENT

### 2-19. Fire Extinguisher

a. *General.* The dry chemical type fire extinguisher is mounted on a bracket in the operator's compartment.

b. *Operation.* Remove the fire extinguisher from its bracket, lift the handle, press the lever, and direct the powder at the base of the flame using a side-to-side sweeping motion.

c. *Maintenance.* Weigh the fire extinguisher every six months and replace if weight is less than 4½ pounds or if pressure is below 125 pounds.

### 2-20. Cold Start Kit

a. *General.* The cold start kit consists of a cylinder filled with ether, a valve, a tube and an aspirator in the intake manifold. Pushing the switch mounted on the instrument panel opens the valve and permits ether to flow to the manifold, where it is drawn into the engine cylinders.

b. *Operation.*

(1) Depress the switch and wait for 3 seconds.

(2) Engage the starter. If engine fails to start, repeat procedure.

(3) Use the starting kit only in temperatures below 15° F.

c. *Servicing.* Refer to paragraph 4-20 for cold start kit servicing.

**CAUTION:** When the loader is to be used in a warm climate, remove the ether cylinder. This will prevent inadvertent injection of the fluid and possible damage to the engine.

### 2-21. Tire Inflation Kit.

A tire inflation kit (fig. 2-12) utilizes air from the main air reservoir to fill tires in the field. The kit consists of a hose which fits onto the tee at the reservoir check valve, an air chuck, and a pressure gage.

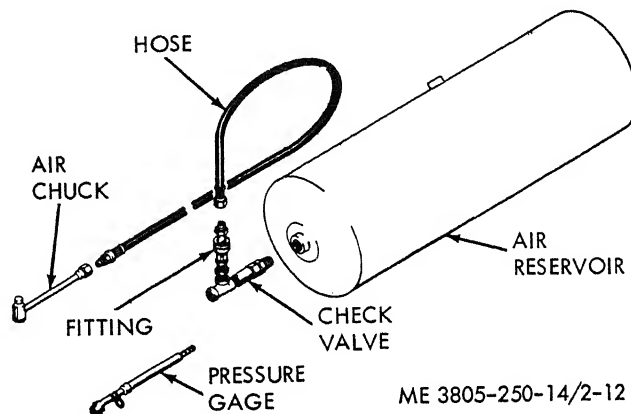


Figure 2-12. Tire inflation kit.

## CHAPTER 3

### OPERATOR / CREW MAINTENANCE INSTRUCTIONS

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#### Section I. BASIC ISSUE ITEMS

- 3-1. Tools and Equipment**      with the loader are listed in the Basic Issue Items List, Appendix C of this manual.
- Tool and equipment issued or authorized for use

#### Section II. LUBRICATION INSTRUCTIONS

- 3-2. General**      foreign material from contaminating the lubricant.
- This section contains lubrication instructions to prevent the Lubrication Order. Refer to DA Pam 0.4 for current L.O.      *b. Cleaning.* Keep lubrication points clean and keep lubricants off items which do not require lubrication.
- 3-3. Detailed Instructions**      *c. Points of Lubrication.* Service the points of lubrication at required intervals. Refer to the Lubrication Order.
- a. General.* Keep all lubricants in closed containers and store in a cool, dry place. Prevent

#### Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

- 3-4. General**      **3-5. Daily Preventive Maintenance**
- The loader must be inspected daily for defects and servicing to ensure that it is ready for operation at all times. Defects should be corrected before they result in serious damage or failure.      Refer to table 3-1 for preventive maintenance services. Sequence numbers indicate the sequence of minimum requirements.

#### Section IV. TROUBLESHOOTING

- 3-6. General**      list of probable causes and possible remedies. Refer to table 3-2 for any trouble beyond the scope of operator maintenance to organizational or direct and general support maintenance personnel.
- Table 3-2 provides information for diagnosing and correcting improper operation or failure of the components. Each symptom is followed by a



Table 3-1. Daily Preventive Maintenance

Sequence number			Item to be inspected	Procedure	Paragraph reference
Before operation	During operation	After operation			
1	—	3	Fuel tank	Drain condensation and sediment. Add fuel as required.	3-9
2	—	5	Fuel filters	Change filter element as necessary.	3-10
3	—	4	Hydraulic tank	Check oil level.	3-11
4	—	6	Radiator	Check coolant level.	2-1
5	—	7	Air cleaner	Check restriction indicator. Clean unloader. Service if necessary.	3-8
6	—	2	Engine crankcase	Check oil level and replenish as necessary.	3-7
7	—	11	Tires	Inspect for cuts and damage. Check for 45 psi pressure.	3-14
8	—	8	Air reservoirs	Drain condensation.	3-19
9	—	9	Fan belts	Check for proper tension.	3-16
10	—	10	Compressor belt	Check for proper tension.	3-16
11	—	12	Alcohol evaporator	Check and add fluid (cold weather).	3-12
—	1	1	Controls and instruments	Inspect for proper indication.	2-8

Table 3-2. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Engine cranks but fails to start. 2. Engine hard to start.	Insufficient fuel. a. Insufficient fuel or incorrect grade.	Check fuel tank (para 3-9). a. Check tank and fill with correct grade fuel (para 3-9).
3. Engine stops suddenly. 4. Engine overheats. 5. Engine power low. 6. Engine emits black smoke in exhaust. 7. Engine oil pressure low.	b. Clogged fuel filter. c. Insufficient air to engine. Fuel tank empty. Coolant level low. Insufficient air to engine. Insufficient air to cylinders.	b. Service filter (para 3-10). c. Service air cleaner (para 3-8) Fill tank (para 3-9). Check and fill radiator (para 2-1). Service air cleaner (para 3-8). Service air cleaner (para 3-8).
8. Air intake system not operating properly. 9. Exhaust system not operating properly. 10. Bucket arms do not operate. 11. Wheel brakes do not stop the loader.	a. Crankcase oil level low. b. Oil leak Clogged air cleaner.  a. Restricted exhaust pipe. b. Loose clamps. Low hydraulic oil. Leak in air system.	a. Fill crankcase (para 3-7). b. Check oil lines. Service (para 3-8).  a. Inspect and clean. b. Tighten. Check and replenish (para 3-11). Check for loose connections.

## Section V. MAINTENANCE OF THE MW24 LOADER

### 3-7. Engine

#### a. Inspection.

- (1) Inspect attaching bolts, nuts, screws and clamps for tightness.
- (2) Inspect lubrication and cooling line connections for signs of leakage.
- (3) Inspect hoses and belts for deterioration.
- (4) Inspect housings for chips or cracks.

(5) Inspect engine components for dents, bends or other damage.

#### b. Service.

- (1) Check the crankcase oil level daily as follows;
  - (a) Check the oil level with the dipstick and add oil as necessary to bring the oil level to the "FULL" mark on the dipstick (fig. 3-1).

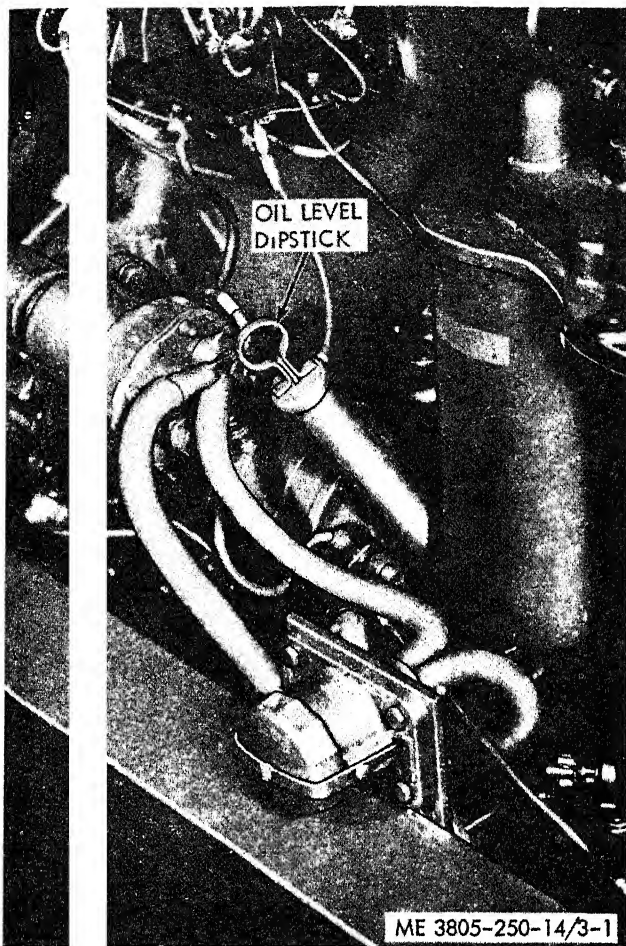


Figure 3-1. Checking crankcase oil level.

(b) Wait 2 or 3 minutes to let the oil drain into the crankcase and again check the oil level.

(2) Change the crankcase oil as follows:

(a) With the engine at operating temperature, remove the magnetic drain plug from the oil pan and allow the oil to drain.

(b) Clean the drain plug and install with a new gasket. Tighten securely.

(c) Fill the crankcase with 17 quarts of engine oil if the oil filter was not changed or with 19 quarts of engine oil if the oil filter was changed.

(d) Pull out the fuel shutoff control and crank the starter for 15 seconds to lubricate the turbocharger.

(e) Start the engine and check for leaks.

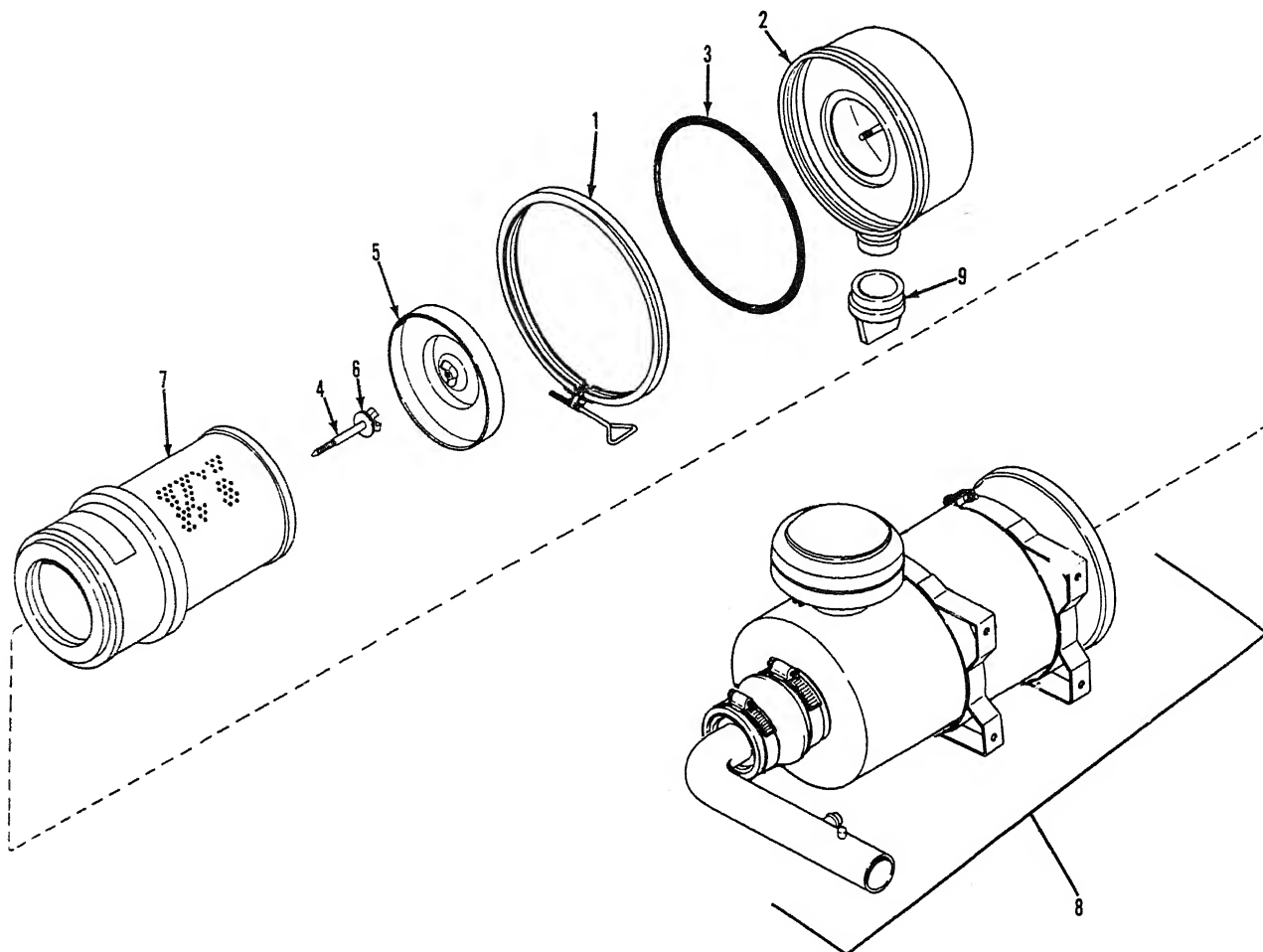
### 3-8. Air Cleaner Service

a. Whenever the red signal appears in the air cleaner service indicator (fig. 2-5), the air cleaner must be serviced.

b. Loosen the clamp (1, fig. 3-2) and remove the cup (2) and gasket 3.

c. Loosen wing nut (4), and remove the baffle (5) and gasket (6). Slide out the filter element (7) from the body (8).

d. Remove the unloader (9) from the cup.



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1. Clamp
2. Cup
3. Gasket
4. Wing nut

5. Baffle
6. Gasket
7. Filter element
8. Body

Figure 3-2. Air cleaner, exploded view.

e. Clean the exterior and interior of the air cleaner body (8).

f. Blow dust and dirt from the element with compressed air. Blow from the inside out.

*Note.* The filter element may be cleaned and reused as many as six times before it must be replaced. Tag the element to record the number of times it has been cleaned.

g. Install filter element and reassemble the air cleaner.

h. Push in the reset button on the air cleaner indicator and release.

### 3-9. Fuel Tank Service

a. *Adding Fuel.* Check the level of fuel in the fuel tank by withdrawing the dipstick (fig. 3-3). Add fuel as necessary to bring the level up to the "FULL" mark. Always clean the filler neck area before removing the filler cap. Fill the tank at the end of each work day to help prevent moisture from collecting in the fuel system. Fuel tank capacity is 74.2 gallons.

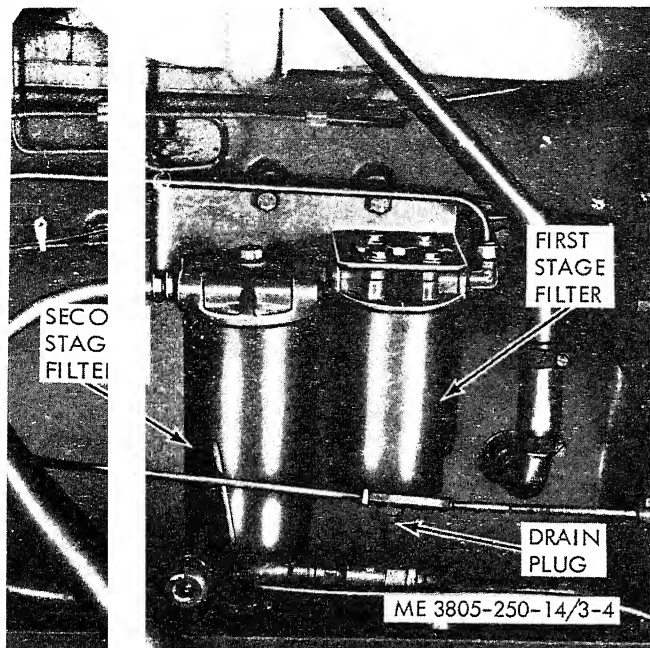


Figure 3-3. Checking fuel level.

b. Draining. Remove the plug from the bottom of the tank and allow the fuel to drain.

### 3-10. Fuel Filter Service

- Remove the right engine side panel.
- Close the fuel tank shutoff valve and remove the drain plug from the first stage filter (fig. 3-4).

c. Turn the filters counterclockwise and remove from the mounting bracket.

d. Remove and discard the filter elements. Apply a thin coat of grease to the new filter gaskets.

e. Install the new filters by turning clockwise until the gasket just contacts the filter head. Hand tighten  $1/2$  to  $3/4$  turn.

f. Open the fuel shutoff valve.

g. Open the bleed valve on the second stage filter and manually actuate the electric fuel pump. When clear, bubble-free fuel appears, close the bleed valve.

h. Install the engine side panel.

### 3-11. Hydraulic Oil Reservoir

#### a. Inspection.

(1) Inspect the reservoir and connecting lines for leaks.

(2) Check mounting bolts to ensure that the reservoir is held securely in position.

(3) Inspect the reservoir for corrosion and for dirt, mud and grease which could contaminate the oil.

#### b. Service. (fig. 3-5).

(1) Remove the front access panel.

(2) Close the air valve on the hydraulic reservoir and slowly withdraw the dipstick. (1). Retain the gasket (2).

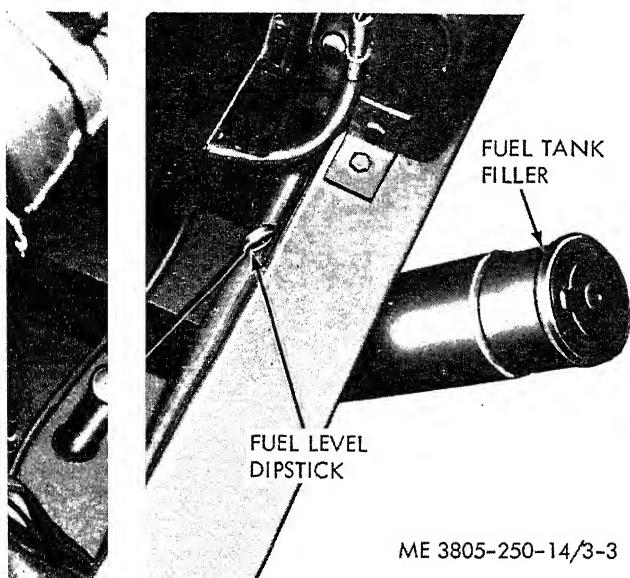
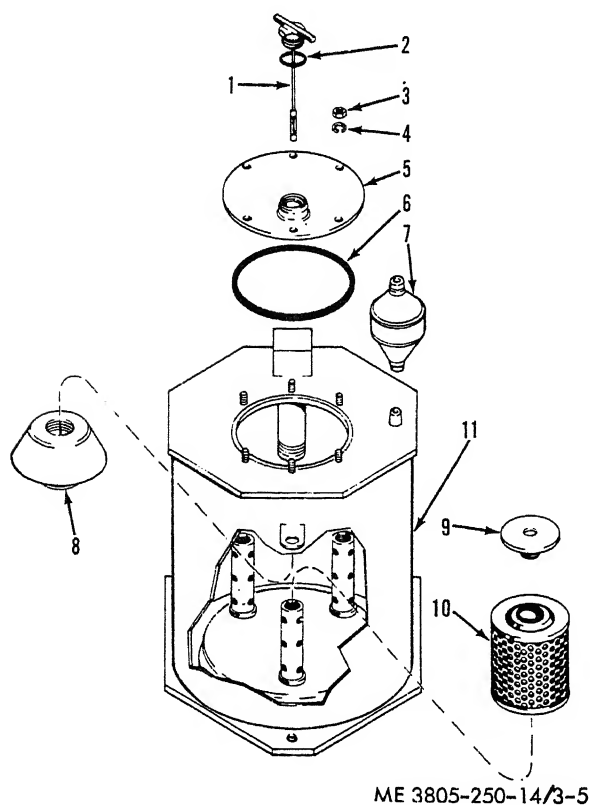


Figure 3-4. Fuel filter service.



- |               |                        |
|---------------|------------------------|
| 1. Dipstick   | 7. Breather            |
| 2. Gasket     | 8. Inlet filter screen |
| 3. Nut        | 9. Relief valve        |
| 4. Lockwasher | 10. Filter element     |
| 5. Top cover  | 11. Reservoir          |
| 6. Gasket     |                        |

Figure 3-5. Hydraulic oil reservoir service

(3) Remove nuts (3) and lockwashers (4) securing the top cover (5). Remove the cover and the gasket (6).

(4) Remove two drain plugs from the bottom of the reservoir and allow the oil to drain.

(5) Remove the breather (7) and check for restrictions. Clean in solvent.

(6) Remove the inlet filter screen (8) and clean in solvent.

(7) Remove the relief valves (9).

(8) Remove and discard the filter elements (10).

(9) Clean the inside of the reservoir (11) with a lint-free cloth.

(10) Install new filter elements (10). Install the relief valves (9), inlet filter screen (8), breather (7), drain plugs, gasket (6) and the top cover (5).

Secure cover with nuts (3) and lockwashers (4). Tighten the cover nuts to a torque of 30 to 40 pound-feet.

(11) Fill the reservoir with 20.8 gallons of hydraulic oil. Refer to the Lubrication Order.

(12) Install gasket (2) and dipstick (1).

(13) Open the air valve at the reservoir and start the engine. Do not operate engine over low idle speed until the air pressure gage at the reservoir indicates between 13 and 19 psi.

(14) Operate the bucket through a complete cycle and turn the steering wheel to extreme right and left.

(15) Shut down the engine and close the air valve.

(16) Check the oil level with the dipstick. Add oil if necessary and repeat steps (13) through (15).

(17) Install the front access panel.

### 3-12. Alcohol Evaporator Service

In freezing temperatures, check the level of alcohol in the evaporator (fig. 3-6) each day and replenish if necessary. To check the level or fill, remove the right engine side panel and remove the plug from the top of the evaporator.

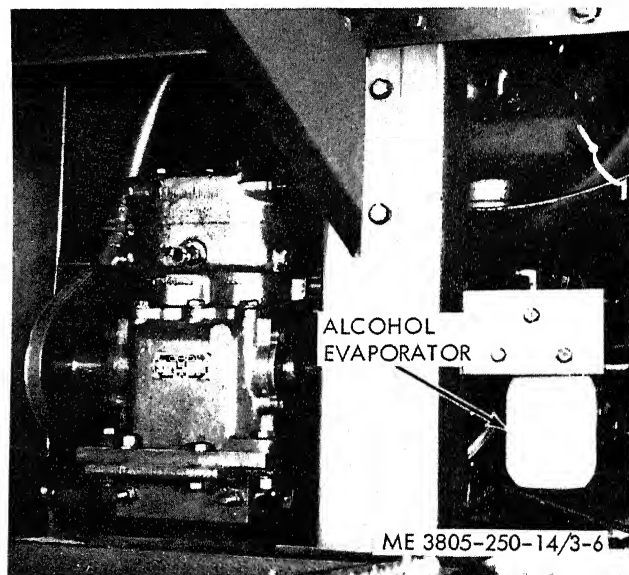


Figure 3-6. Alcohol evaporator service.

### 3-13. Seat Adjustment

a. To adjust the seat vertically, loosen two wing nuts (fig. 3-7) on each side of the seat. Move the seat up or down as required. The seat is adjustable four inches in the vertical direction.

b. To adjust the seat horizontally depress the seat adjustment lever (fig. 3-7) and move the seat forward or backward, as required.

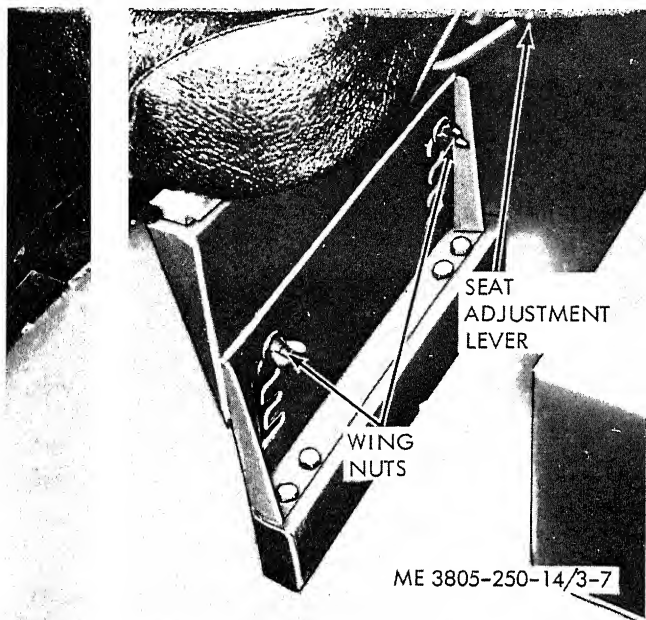


Figure 3-7. Seat adjustment.

### 3-14. Tires

a. *Inspection.* Periodically inspect tires for cuts, smooth spots, and uneven wear.

b. *Service.* Check tire air pressure and maintain pressure at 45 psi (cold).

### 3-15. Axles Inspection

Inspect the differentials and planetaries for evidences of cracks, leaks and damage.

### 3-16. Fan and Alternator Belts Inspection

a. Check belts for wear, cracks, or fraying.

b. Check belts for proper adjustment. Deflection should be one-half inch at a point midway between the pulleys when a pressure of 60 pounds is applied.

### 3-17. Steering Components Inspection

a. Inspect steering gear housing for cracks or other damage.

b. Inspect the mounting brackets and attaching hardware for security.

c. Check hydraulic lines for leaks.

d. Inspect steering cylinders for leaks at the rod end packing.

### 3-18. Hydraulic Cylinders Inspection

a. Inspect cylinder rod end packings for leaks.

b. Inspect pivot points for an accumulation of dirt or grease.

c. Inspect hoses for cracks, leaks or deterioration.

### 3-19. Air Reservoirs Draining

a. *Main Air Reservoir.* Open the drain cock on the bottom of the main air reservoir and allow to drain.

b. *Auxiliary Air Reservoir.* Open the drain cock on the extension from the auxiliary air reservoir and allow to drain.

## CHAPTER 4

## ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

## Section I. SERVICE UPON RECEIPT OF MATERIAL

## 4-1. Inspecting and Servicing the Equipment

No special inspecting and servicing is required of

organizational maintenance personnel. Refer to paragraph 2-1 for operator inspecting and servicing requirements.

## Section II. MOVEMENT TO A NEW WORKSITE

## 4-2. General

a. The loader does not require dismantling before moving to a new worksite.

b. Movement instructions for organizational

maintenance personnel are the same as for the operator (para 2-3).

**CAUTION:** If the loader is to be pushed or towed for distances greater than ½ mile, disconnect drive shafts.

## Section III. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

## 4-3. Tools and Equipment

Tools and equipment issued with, or authorized for, the MW24 Scoop Loader are listed in the Basic Issue Items List, appendix C.

## 4-4. Special Tools and Equipment

Organizational maintenance personnel will be required to use Battery Tester 6625-647-4112

(BST5) for battery testing procedures. Refer to paragraph 4-34.

## 4-5. Maintenance Repair Parts

Repair parts and equipment are listed and illustrated in the repair parts manual, TM5-5805-250-20P.

## Section IV. LUBRICATION INSTRUCTIONS

## 4-6. General

This section contains lubrication instructions to supplement the Lubrication Order.

## 4-7. Detailed Instructions

a. *General.* Keep all lubricants in closed containers and store in a clean dry place away from external heat. Prevent dust, dirt, and other foreign

material from contaminating the lubricant.

b. *Cleaning.* Keep all external parts which do not require lubrication clean of lubricants. Before and after lubricating, clean lubrication points.

c. *Points of Lubrication.* Service the points of lubrication at the required intervals. Refer to the lubrication Order.

## Section V. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (MONTHLY AND QUARTERLY)

## 4-8. General

The loader must be systematically and periodically inspected for defects to ensure that it is ready for operation at all times. Defects should be corrected before they result in serious damage or failure.

## 4-9. Preventive Maintenance Services

Refer to table 4-1 for preventive maintenance services. Item numbers indicate the sequence of minimum requirements.

## Section VI. TROUBLESHOOTING

## 4-10. General

Table 4-2 provides information for diagnosing and correcting improper operation or failure of the loader components. Each trouble symptom is

followed by a list of probable causes and possible remedies. Refer any trouble beyond the scope of organizational maintenance to direct and general support maintenance personnel.



Table 4-1. Monthly Preventive Maintenance Checks and Services

Item Number	Item to be inspected	Procedure	Paragraph reference
1	Radiator	Check for leaks. Check cooling fins for damage.	4-25
2	Axles	Check oil level. (Also check at 100 hours.)	4-41
3	Planetary hubs	Check oil level. (Also check at 100 hours.)	4-41
4	Transmission	Check oil level. Service filter and strainer.	4-40
5	Brake actuators	Check fluid level. (Also check at 100 hours.)	4-44
6	Batteries	Check specific gravity (Also check at 100 hours.)	4-34
7	Hydraulic system	Clean screen. Tighten fittings.	3-11
8	Engine oil filter	Replace filters. (Also replace at 100 hours.)	4-13
9	Turbocharger	Inspect for air, exhaust, and oil leaks or unusual noises. (Also check at 100 hours.)	
10	Wheel lug nuts	Check torque. Tighten nuts to a torque of 380 to 420 pound-feet. (Also check at 100 hours.)	
11	Screws, nuts, and pins	Check and tighten as required. (Also check at 100 hours.)	1-7
12	Crankcase breather	Clean tube. (Also clean at 100 hours.)	4-14
13	Water pump	Check for leaks and loose mounting.	
14	Fuel injection pump	Check for leaks and loose mounting. Check and clean fuel strainer.	4-19
15	Fuel injection nozzles	Inspect for leaks and damage. Check mounting nut torque for 9 to 12 pound-feet.	
16	Belts	Check belts for fraying and stretching. Adjust belts.	4-27, 4-65
17	Alternator	Check for loose mounting and electrical connections. Tighten screws. Replace defective alternator.	4-30
18	Ground	Check for proper ground and tighten all ground connections.	
19	Thermostat	Check for leaks and damaged hose. Check thermostat operation. Replace defective thermostat.	4-28

Table 4-2. Troubleshooting

Malfunction	Probable Cause	Corrective Action
1. Engine fails to turn over.	a. Defective neutral start switch. b. Weak or defective batteries. c. Defective starter.	a. Replace switch. b. Charge or replace (para 4-34). c. Replace (para 4-32).
2. Engine cranks but fails to start.	a. Cranking speed too slow.  b. Insufficient fuel.  c. Fuel injection nozzles not receiving fuel.	a. Charge or replace batteries (para 4-34). b. Check fuel system and add as necessary (para 3-9). c. Check fuel system.
3. Engine hard to start.	a. Insufficient fuel or incorrect grade. b. Clogged filter or sediment. c. Insufficient air to engine.	a. Check tank and fill with correct grade (para 3-9). b. Check fuel system and service filter (para 3-10). c. Check and service air cleaner. Replace element if necessary (para 3-8).
4. Engine stalls	Restricted fuel supply or air in fuel system.	Check fuel system and correct.
5. Engine stops suddenly.	a. Fuel tank empty. b. Restricted fuel supply or damaged fuel lines.	a. Fill fuel tank (para 3-9). b. Check fuel system and correct.
6. Engine overheats.	a. Coolant level low. b. Radiator air passages clogged. c. Fan belts loose or damaged.	a. Check and fill radiator (para 2-1). b. Clean radiator (para 4-24). c. Adjust belts (para 4-27) or replace (para 4-27).
7. Engine power low.	d. Defective thermostat. a. Insufficient air to cylinders.  b. Insufficient fuel to nozzles.	d. Replace (para 4-28). a. Check fuel system. Service air cleaner (para 3-8). Replace element if necessary. b. Check fuel system and correct.

Malfunction	Probable Cause	Corrective Action
8. Engine runs unevenly and vibrates excessively.	a. Fuel supply erratic or insufficient. b. Engine operating temperature too low.	a. Check fuel system and correct. b. Check thermostat (para 4-28) and replace.
9. Engine emits black smoke in exhaust.	Insufficient air to cylinders.	Check and service air cleaner. Replace element if necessary (para 3-8).
10. Engine oil pressure low.	a. Crankcase oil level low. b. External oil leak. c. Defective oil pressure gage.	a. Check oil level and fill (para 3-7). b. Check oil lines. c. Replace gage (para 4-63).
11. Starter does not crank engine.	a. Batteries weak.  b. Loose connections or cables.  c. Defective starter switch. d. Defective starter.	a. Charge or replace batteries (para 4-34).  b. Clean terminals and tighten connections. c. Replace switch. d. Replace starter (para 4-32).
12. Electrical system not providing power.	a. Batteries weak.  b. Defective cables. c. Defective alternator. d. Defective alternator regulator.	a. Charge or replace batteries (para 4-34).  b. Clean and tighten cables or replace. c. Replace (para 4-30). d. Replace (para 4-31).
13. Alternator not charging.	a. Broken or loose belt.  b. Defective voltmeter. c. Defective circuit breaker. d. Defective alternator regulator.	a. Adjust (para 4-27) or replace (para 4-30).  b. Replace (para 4-63). c. Replace. d. Replace (para 4-31).
14. Loader lights do not illuminate.	a. Lamps burned out. b. Defective circuit breaker. c. Loose wire connections.  d. Defective light switch.	a. Replace (para 4-36). b. Replace c. Check wiring and tighten connections. d. Replace switch (para 4-63).
15. Air intake system not operating properly.	a. Clogged air cleaner.	a. Service (para 3-8).
16. Exhaust system not operating properly.	b. Defective air hoses and piping. a. Restricted exhaust pipe. b. Loose or defective clamps.	b. Check and replace as necessary. a. Inspect and clean. b. Tighten or replace clamps.
17. Loader will not move.	a. Engine power low. b. Transmission oil level low.	a. Refer to trouble 7. b. Check and replenish (para 4-40).
18. Loader does not steer properly.	a. Oil level low. b. Leaky or defective hydraulic lines.	a. Check and replenish b. Tighten connections or replace lines.
19. Bucket arms do not lift or lower.	a. Low hydraulic oil. b. Clogged hydraulic filter. c. Leaky or defective lines.	a. Check and replenish (para 3-11). b. Replace filter (para 3-11). c. Tighten connections or replace.
20. Bucket does not operate properly.	a. Low hydraulic oil. b. Clogged hydraulic filter. c. Leaky or defective hydraulic lines.	a. Check and replenish (para 3-11) b. Replace filter (para 3-11). c. Tighten connections or replace.
21. Wheel brakes do not stop loader.	a. Insufficient air pressure. b. Insufficient hydraulic fluid in actuator. c. Air in brake system. d. Brakes not properly adjusted. e. Leaky brake lines f. Compressor belt loose. g. Leaky or defective air lines.	a. Check air system and correct. b. Check and replenish (para 4-44).  c. Bleed brake system (para 4-43). d. Adjust brakes e. Tighten connections. f. Adjust belt (para 4-65). g. Tighten connections or replace air lines.
22. Parking brake does not hold.	h. Defective compressor governor. a. Lever or linkage out of adjustment.	h. Replace (para 4-64). a. Adjust (para 4-42).

## Section VII. RADIO INTERFERENCE SUPPRESSION

### 4-11. General

a. *General Methods Used to Attain Proper Suppression.* Essentially, suppression is attained by providing a low resistance path to ground for the stray currents. The methods used include shielding the ignition and high-frequency wires, grounding the frame with bonding straps, and using capacitors and resistors.

b. *Interference Suppression Components.* Suppression components include a capacitor, mounted on the alternator brush, a suppressor, mounted behind the left vertical support, a 0.1 microfarad capacitor connected to the horn switch, a 24 volt diode connected to the high converter temperature warning buzzer, and a 24 volt diode connected to the low air pressure warning buzzer. Refer to figure 1-3 for the loader wiring diagram.

### 4-12. Replacement.

a. To replace the suppressor, remove the right side engine panel. Remove bolts and lockwashers securing the vertical support in position and rotate the vertical support 180 degrees. Remove three nuts, bolts and lockwashers securing the suppressor to the vertical support. Tag and disconnect wiring, and remove the suppressor from the loader. Install suppressor by reversing the removal procedure.

b. To remove diodes or the horn switch capacitor, tag and disconnect wiring. Install by connecting wiring.

c. The capacitor on the alternator brush is replaced with the alternator brush. This is a function of direct and general support personnel.

## Section VIII. MAINTENANCE OF THE ENGINE LUBRICATION SYSTEM

### 4-13. Oil Filter Service

a. Start the engine and allow the engine oil to reach normal operating temperature. Shut down the engine.

b. Remove the drain plug from the oil pan and drain the lubricating oil from the engine.

c. Remove the left engine side panel.

d. Remove the filter (fig. 9-1) by turning in a counterclockwise direction.

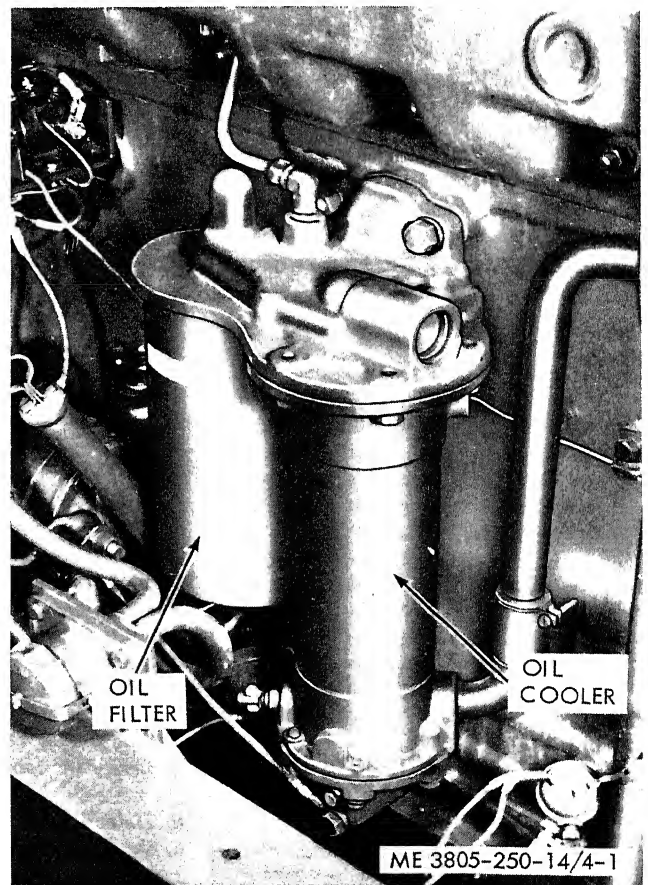


Figure 4-1. Engine oil filter and oil cooler assembly.

e. Discard the filter element.

f. Apply a thin coat of oil or grease to the new filter gasket. Spin on the filter until the gasket contacts the filter mounting. Hand-tighten an additional  $\frac{1}{2}$  to  $\frac{3}{4}$  turn.

g. Install the oil pan drain plug, and fill the crankcase with 19 quarts of engine oil. Refer to paragraph 3-7 for engine servicing instructions.

h. Install the engine side panel.

#### 4-14. Crankcase Breather

a. *Replacement.* (fig. 4-2)

(1) Remove the exhaust pipe (para 4-22), air cleaner (para 4-21), side engine panels, and hood (para 4-51).

(2) Remove three screws, washers, and gaskets securing the breather tube to the rocker arm cover. Discard the gaskets.

(3) Remove two bolts and washers which secure the tube bracket. Remove the tube.

(4) Install the tube by reversing the removal procedure.

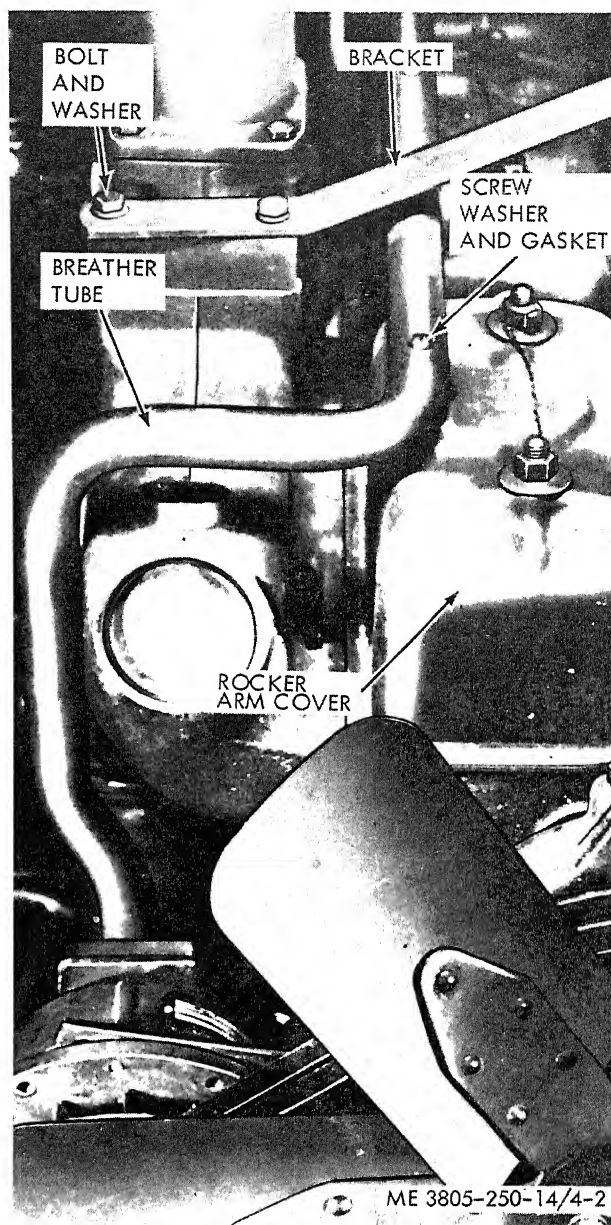


Figure 4-2. Crankcase breather.

b. *Service.* Remove the tube and check for restrictions. Clean with solvent.

#### 4-15. Hose, Lines and Fittings Replacement

Inspect engine lubrication system hose, lines and

fittings for deterioration or damage which may result in leaks. Replace defective items with new components. Tighten fittings securely.

### Section IX. MAINTENANCE OF THE FUEL SYSTEM

#### 4-16. Electric Fuel Pump

a. *General.* The electric fuel pump, mounted on the fuel tank, helps transfer fuel from the tank to the fuel filters.

b. *Removal.*

(1) Disconnect the electrical connector (fig. 4-3).

(2) Remove elbow nut, sleeve, and elbow connecting the fuel tank suction line to the fuel pump inlet port.

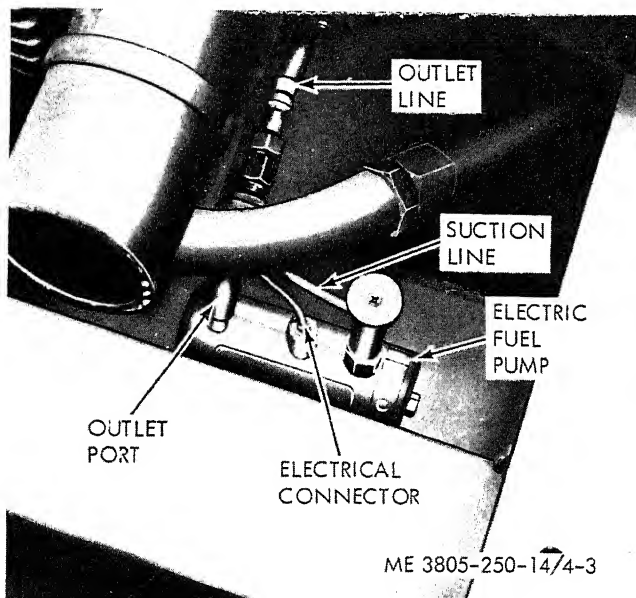


Figure 4-3. Electric fuel pump, removal and installation.

(3) Remove the connector, elbow, and nipple securing the outlet line to the fuel pump outlet port.

(4) Remove the two bolts and washers securing the fuel pump to the fuel tank, and remove the fuel pump.

c. *Installation.* Install pump in reverse order of removal.

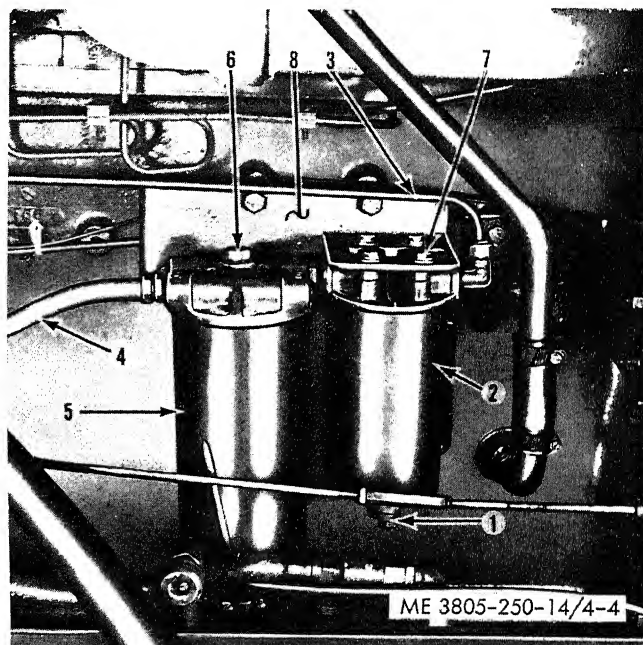
#### 4-17. Fuel Filters

a. *General.* The fuel filter assembly, mounted on the right side of the engine, consists of a primary and secondary filter. The filters remove dissolved air and impurities from the fuel before it is pumped into the fuel injection pump.

b. *Removal.*

(1) Remove the drain plug (1, fig. 4-4) from the first stage filter (2) and drain the filters.

(2) Disconnect the line (3) to the first stage filter and the line (4) to the second stage filter (5).



1. Drain plug
2. First stage filter
3. Line
4. Line
5. Second stage filter
6. Bolt and lockwasher
7. Bolt and lockwasher
8. Bracket

Figure 4-4. Fuel filters, removal and installation.

(3) Remove two bolts and lockwashers (6) securing the second stage filter to the frame.

(4) Remove four bolts and lockwashers (7) securing the first stage filter to the mounting bracket (8). Remove the filter assembly from the loader.

c. *Installation.* Install the filters in the reverse order of removal.

#### 4-18. Accelerator Controls and Linkages

a. *General.* The accelerator is connected by a linkage to the speed control lever on the fuel injection pump governor. This linkage consists of two rods connected to a lever through a cable.

**b. Removal.**

(1) Disconnect the rod (1), fig. 4-5) from governor arm by removing nut (2) and lockwasher (3) and unscrewing ball joint (4).

(2) Remove bolts (5), nuts (6), lockwashers (7) and spacer (8) securing the cable (9) to the cable mounting bracket (10).

(3) Remove bolts (11), lockwashers (12), nuts (13) and clamp (14) securing the cable to frame (15).

(4) Remove cotter keys (16) and yoke pins

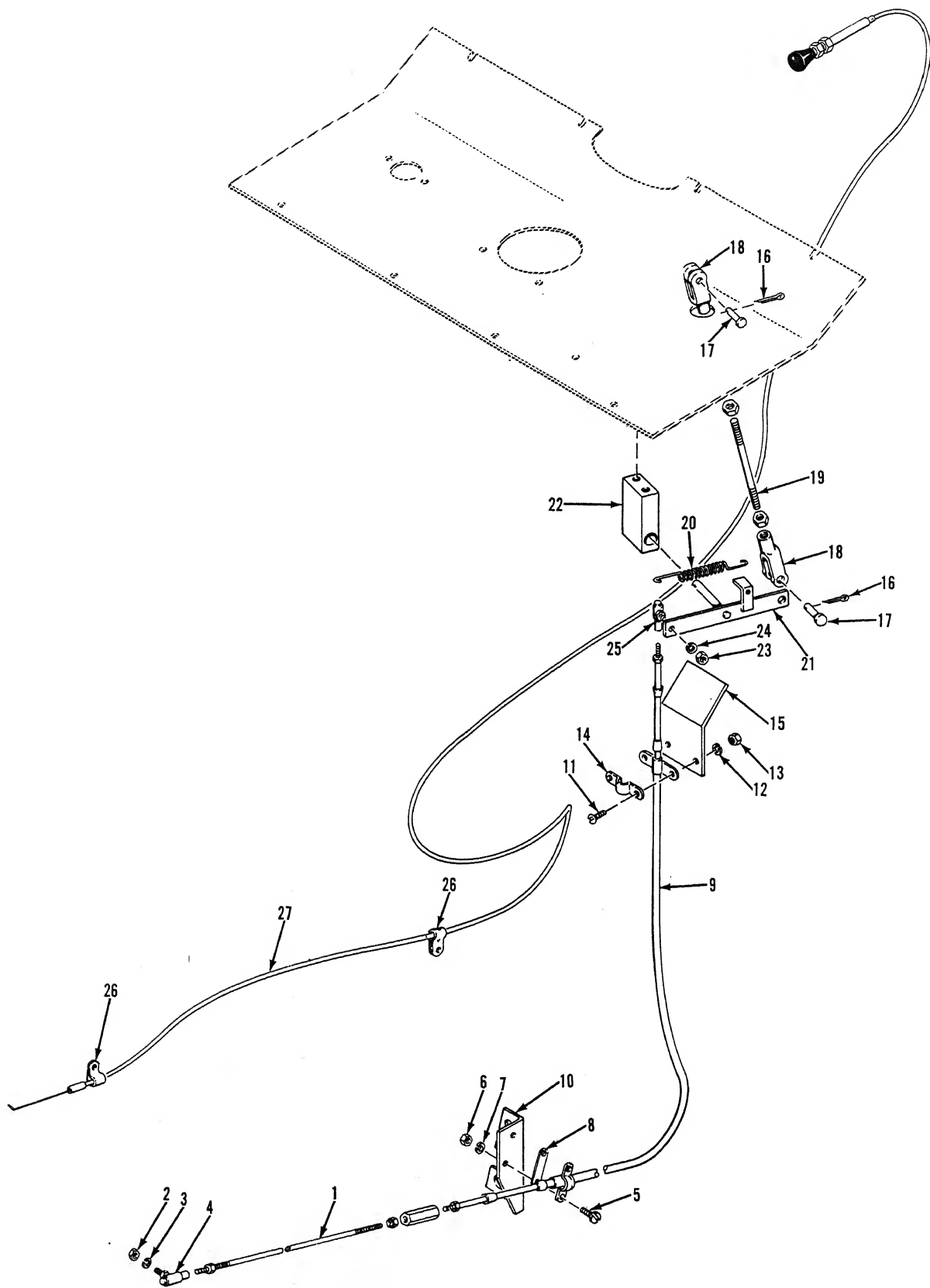
(17) through the accelerator connecting rod yokes (18), and remove the connecting rod (19).

(5) Remove lever return spring (20).

(6) Slide the shaft of lever (21) out of the lever pivot block (22).

(7) Remove the nut (23), lockwasher (24) and ball joint (25) securing the linkage cable (9) to the lever (21).

(8) Remove two clamps (26) securing the fuel shutoff cable (27) to the frame. Remove the accelerator linkage from the loader.



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Figure 4-5. Accelerator linkage.



KEY to fig. 4-5:

- |                 |                 |
|-----------------|-----------------|
| 1. Rod          | 14. Clamp       |
| 2. Nut          | 15. Frame       |
| 3. Lockwasher   | 16. Cotter keys |
| 4. Ball joint   | 17. Yoke pins   |
| 5. Bolts        | 18. Yokes       |
| 6. Nuts         | 19. Rod         |
| 7. Lockwashers  | 20. Spring      |
| 8. Spacer       | 21. Lever       |
| 9. Cable        | 22. Pivot block |
| 10. Bracket     | 23. Nut         |
| 11. Bolts       | 24. Lockwasher  |
| 12. Lockwashers | 25. Ball joint  |
| 13. Nuts        | 26. Clamps      |
|                 | 27. Cable       |

c. *Installation.* Install the linkage in the reverse order of removal.

d. *Throttle Adjustment* (fig. 4-6).

(1) Stop the lever shaft against the lever pivot block.

(2) Adjust the accelerator rod until the angle formed by the accelerator pedal and the floor plate is 42 degrees. Tighten the jam nuts on the accelerator rod.

(3) Use a tachometer capable of reading 2500 rpm. to monitor engine speed. Start the engine.

(4) Adjust the turnbuckle on the throttle rod to obtain a tachometer indication of 725 to 775 rpm. Tighten the jam nuts on the throttle rod.

(5) Adjust the pedal stop bolt to obtain an indication of 2315 to 2365 rpm when the accelerator pedal contacts the stop bolt. Tighten the jam nut.

(6) Shut down the engine and remove the tachometer.

e. *Fuel Shutoff Control Adjustment* (fig. 4-7).

(1) Loosen the setscrew on the fuel shutoff arm pivot. The shutoff arm returns to the run position when released.

(2) Push the fuel shutoff handle in until it seats against the mounting ferrule. If necessary, loosen the cable mounting clamps to position the cable in the shutoff arm pivot.

(3) Tighten the cable pivot setscrew and the cable clamps, if loosened.

(4) Start the engine and pull the full shutoff handle all the way out. The engine should stop.

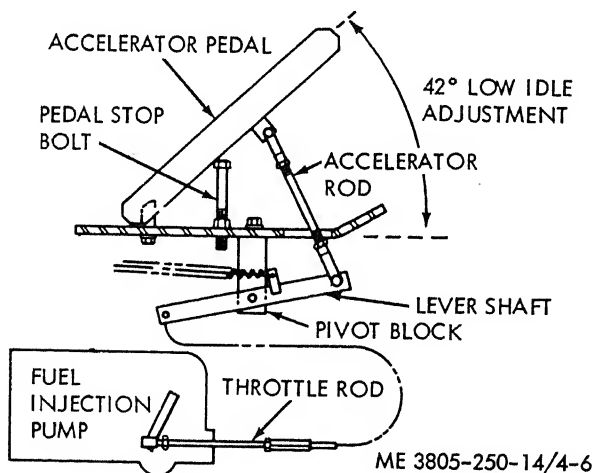


Figure 4-6. Throttle adjustment.

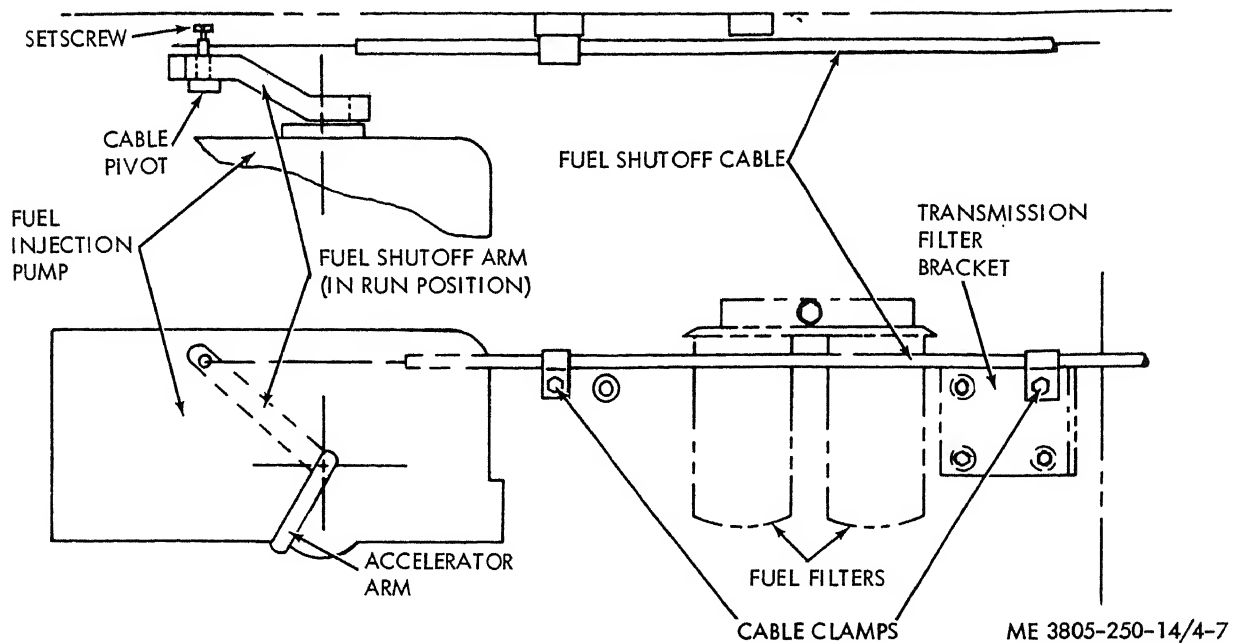


Figure 4-7. Fuel shutoff control adjustment.

#### 4-19. Fuel Tank

##### a. Removal.

- (1) Open the drain cock on the bottom of the fuel tank (fig. 4-8) and allow the fuel to drain.
- (2) Disconnect the fuel tank inlet and outlet lines. Cap openings.
- (3) Support the tank with a suitable hoist and remove bolts and lockwashers securing the tank to the frame. Lower the fuel tank to the ground and remove from beneath the loader.

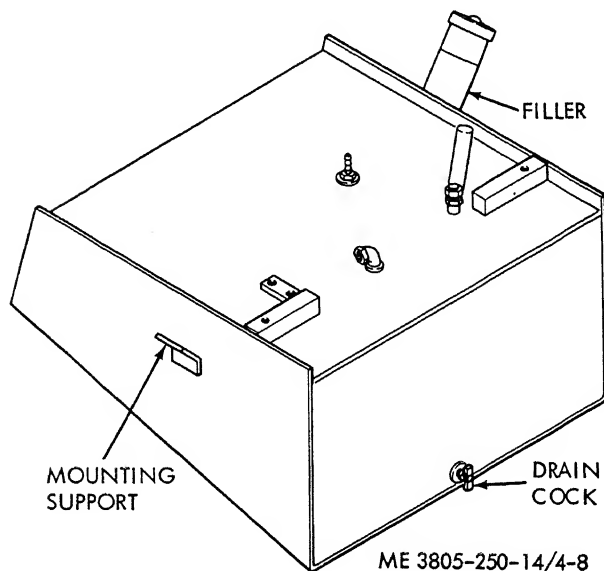


Figure 4-8. Fuel tank.

##### b. Installation.

- (1) Install the tank by reversing the removal procedure.
- (2) Coat fitting pipe threads with sealant and connect inlet and outlet lines. Be careful not to bottom the male pipe threads.
- (3) Service the fuel tank and check for leaks.

c. *Cap Replacement.* Replace damaged or defective cap.

#### 4-20. Cold Start Kit

##### a. General.

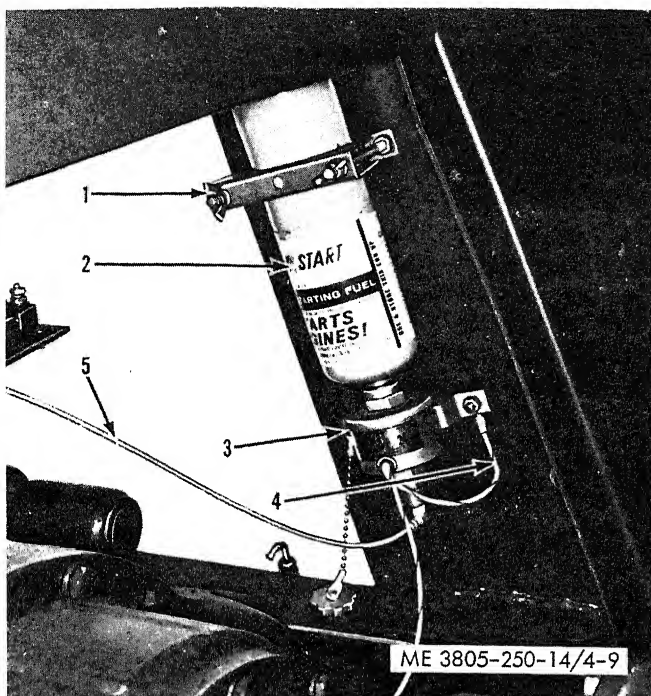
(1) A cold start kit may be installed in the loader to permit easy starting in cold weather. The kit consists of an atomizer in the intake manifold, a cylinder serviced with ether, a valve, electric connections, and a cab-mounted switch.

(2) When the switch is pressed, the valve transfers ether to the atomizer, where it is sprayed into the intake manifold.

(3) The cold start cylinder and valve are mounted under the right side of the forward hood, just behind the hydraulic oil cooler.

##### b. Removal.

(1) Remove two bolts securing the ether cylinder bracket (1, fig. 4-9) in place. Unscrew cylinder (2) from valve (3), and cap the valve.



1. Bracket
2. Cylinder
3. Valve
4. Wiring
5. Outlet tube

Figure 4-9. Cold start kit, removal and installation.

## Section X. MAINTENANCE OF THE AIR INDUCTION AND EXHAUST SYSTEM

### 4-21. Air Cleaner

*a. General.* The air cleaner, mounted above the right fender, removes solid impurities from atmospheric air before the air is directed to the engine cylinders.

*b. Removal* (fig. 4-10).

- (1) Loosen the clamp securing the outlet line to

the air cleaner.

- (2) Disconnect the air cleaner indicator tube.

(3) Support the air cleaner and remove four nuts, bolts and washers securing the air cleaner mounting bracket to the side of the hood.

- (4) Lift the air cleaner and remove from the loader.

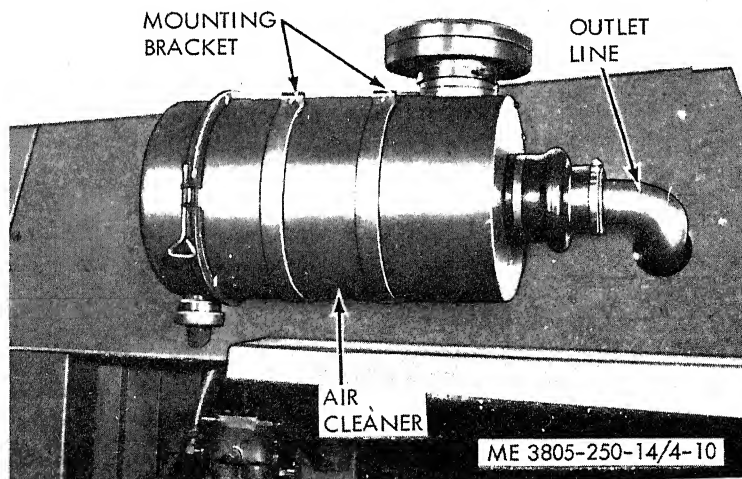


Figure 4-10. Air cleaner, removal and installation.

*c. Installation.* Install the air cleaner by reversing the removal procedure.

*d. Hose and Clamp Replacement.* Replace worn or broken hose with a new hose, and clamp into position. Replace broken clamps.

#### 4-22. Exhaust Pipe

*a. General.* The exhaust pipe is mounted on the top of the hood and provides an outlet passage for exhaust gases.

*b. Inspection.*

(1) Inspect the exhaust pipe for an accumulation of dirt or any foreign matter in the passage.

(2) Check for signs of corrosion and for holes in the pipe.

(3) Ensure that the pipe is held securely in position.

*c. Removal.* (fig. 4-11).

(1) Remove two nuts and lockwashers from the threaded ends of the U-bolt.

(2) Loosen the clamp securing the exhaust pipe to the exhaust elbow.

(3) Lift the exhaust pipe up from the loader, carefully working the exhaust elbow end through the hole on top the hood.

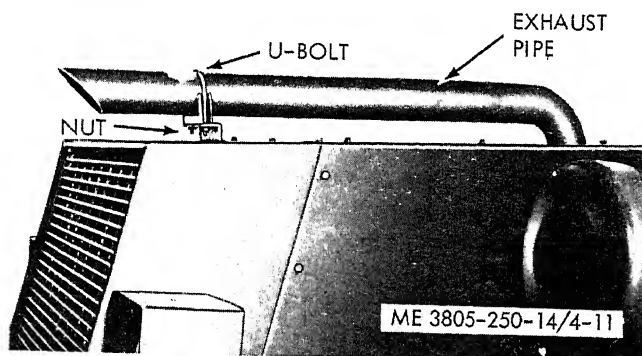


Figure 4-11. Exhaust pipe, removal and installation.

*d. Installation.* Install the exhaust pipe by reversing the removal procedure.

#### 4-23. Intake Manifold

*a. General.* The intake manifold is mounted on the right side of the engine. Air from the turbocharger enters the manifold through the turbocharger air outlet.

*b. Removal.*

(1) Remove four nuts, bolts, and lockwashers securing the intake elbow to the manifold (fig. 4-12).

(2) Remove two bolts which secure the tie rod to the manifold.

(3) Disconnect the engine breather tube.

(4) Remove twelve nuts and lockwashers securing the manifold to the engine. Remove the manifold and discard the mounting gasket.

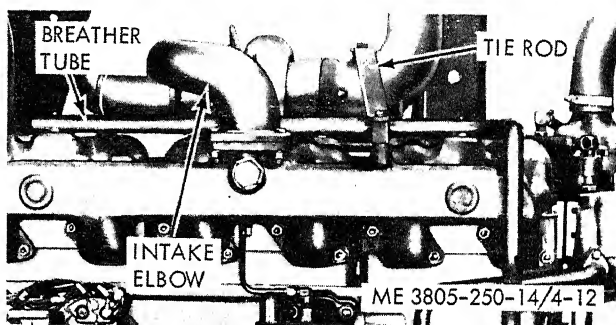


Figure 4-12. Intake manifold, removal and installation.

*c. Installation.* Install new gasket and install manifold by reversing the removal procedure.

### Section XI. MAINTENANCE OF THE COOLING SYSTEM

#### 4-24. Cleaning

*Note:* Cooling system should be cleaned at least once a year. In areas of hard water, clean system more often.

*a.* Add a cooling system cleaner to the radiator and follow directions provided with the cleaner.

*b.* In winter months service radiator with antifreeze.

*c.* In summer months service radiator with water and rust inhibitor.

#### 4-25. Radiator

*a. General.* The fin and tube type radiator is mounted at the rear end of the loader.

*b. Testing.* Drain the radiator and plug the hose connection ports. Apply an air pressure of 200 psi to the filler opening. The radiator must withstand this pressure.

#### 4-26. Shroud

*a. General.* The shroud, bolted to the radiator, directs air through the radiator to provide a better distribution of air.

*b. Replacement.* Remove the side engine access panel and remove the hood (para 4-51). Remove four bolts and lockwashers securing each side of the shroud (fig. 4-13) to the radiator and remove from the loader. Install the shroud by reversing the removal procedure.

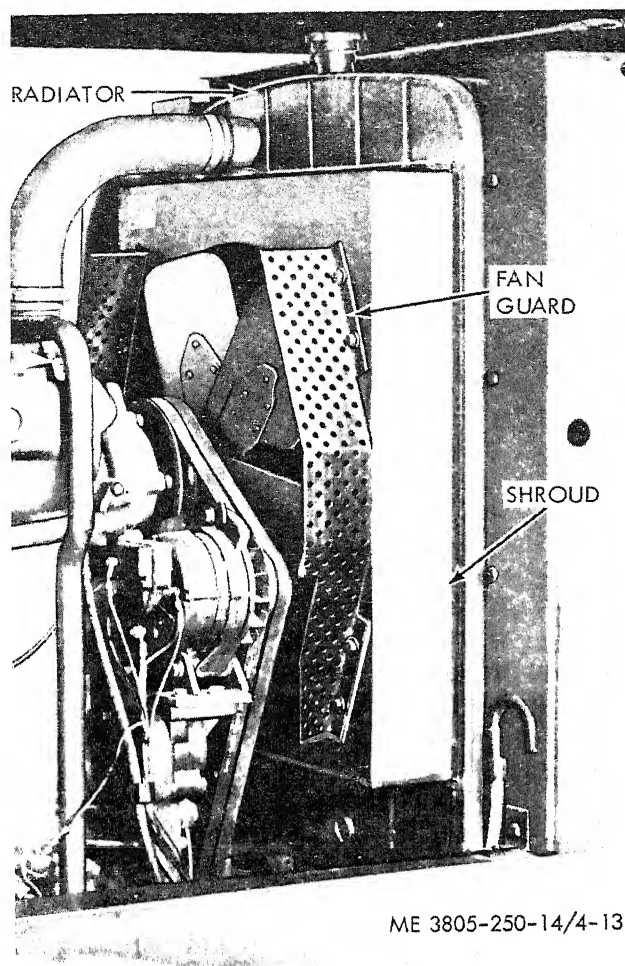


Figure 4-13. Shroud, removal and installation.

#### 4-27. Fan Belts

*a. General.* Two fan belts, routed around the crankshaft pulley, fan pulley and alternator pulley, transfer rotary motion of the engine crankshaft to drive the alternator and the water pump.

*b. Replacement* (fig. 4-14).

(1) Remove the air compressor drive belt (para 4-65).

(2) Loosen the alternator pivot and adjustment bolts.

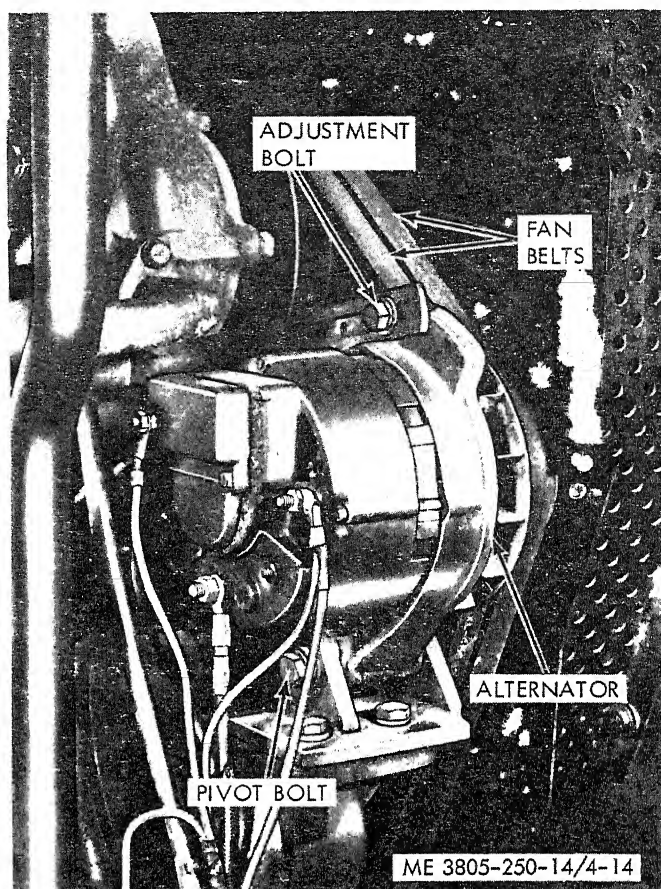


Figure 4-14. Fan belts.

(3) Remove the belts. Slip new belts over the fan and onto the fan pulley, crankshaft pulley, and alternator pulley.

(4) Adjust the belt tension (subpara c).

(5) Install the air compressor drive belt (para 4-65).

*Note.* The fan belts must be replaced as a set.

*c. Adjustment* (fig. 4-14).

(1) Apply a pressure of 60 psi to a point on the belts midway between the alternator and fan pulleys. Deflection should be  $\frac{1}{2}$  inch.

(2) To increase tension, loosen the alternator

pivot and adjustment bolts. Position a small pry bar behind the alternator and pull against the fan belts. Tighten pivot and adjustment bolts when proper tension is obtained.

(3) To decrease tension, loosen the alternator pivot and adjustment bolts and move the alternator inward. Tighten pivot and adjustment bolts when proper tension is obtained.

#### 4-28. Thermostats

*a. General.* The two thermostats are enclosed in a housing mounted on the water manifold. When the engine temperature reaches 180°F, the thermostats open to allow coolant to flow from the water pump back to the radiator.

*b. Removal* (fig. 4-15).

(1) Drain the cooling system.

(2) Disconnect the clamp securing the upper radiator hose to the thermostat housing.

(3) Remove three bolts and lockwashers securing the housing to the manifold. Discard the attaching gasket. Remove the two thermostats from the manifold.

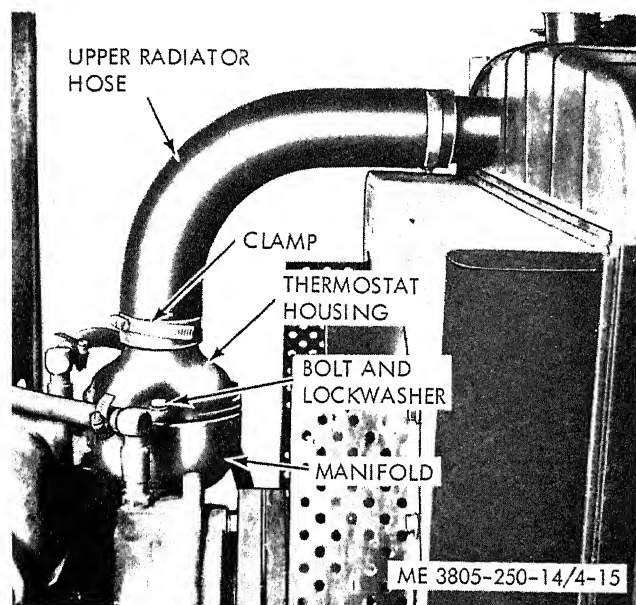


Figure 4-15. Thermostats, removal and installation.

*c. Testing.*

(1) Suspend the thermostat by a wire and

completely immerse in a pan of clean water placed on a heater. Do not allow the thermostat to touch the sides or bottom of the pan. Insert an accurate thermometer capable of reading up to 220°F into the water.

(2) Slowly heat the water while stirring gently to distribute the heat.

(3) Observe the thermostat closely. It should begin to open between 175° and 182°F and should be fully open at 202°F.

(4) Replace the thermostat if it does not open at the proper temperature.

*d. Inspection.*

(1) Inspect attaching hose for cracks and deterioration and replace as necessary.

(2) Inspect housing for leaks and replace if necessary.

*e. Housing Replacement.* Install a new housing if the thermostat housing is cracked, chipped, distorted or otherwise damaged so that coolant can leak out.

*f. Installation.* Install the thermostats by reversing the removal procedure. Service the cooling system and check for leaks.

#### 4-29. Lines, Fittings, Hose and Clamps

*a. General.* The lines, fittings, hose, and clamps form the network through which coolant is distributed to the cooling system components.

*b. Inspection.*

(1) Inspect hose for cracks and deterioration. Replace if necessary.

(2) Check tubes for damage and replace as necessary.

(3) Inspect lines for obstructions and clean as required.

(4) Check fittings for leaks. Install new gaskets if necessary.

(5) Check clamps for tight fit. Replace if necessary.

*c. Replacement.* Replace worn, damaged, or defective components with new components.

*d. Repair.* In emergency situations, broken or damaged hose and lines may be repaired by brazing or binding. Replace defective components when possible.



## Section XII. MAINTENANCE OF THE ELECTRICAL SYSTEM

### 4-30. Alternator

a. *General.* The alternator, mounted on the left side of the engine, is driven by two V-belts. Alternating current is rectified into direct current by diodes which form a rectifier circuit.

b. *Removal.*

**Warning:** Make sure the master switch is off and the battery cables disconnected before removing the alternator. Disconnect the ground cable first.

(1) Disconnect the field terminal (1, fig. 4-16), output terminal (2), ground (3) and regulator terminal (4) from the alternator housing.

(2) Remove the lockwasher and bolt (5) securing the alternator to the mounting bracket (6), and remove the bolt, lockwasher, and two washers securing the alternator to the adjusting brace (7). Remove the alternator from the loader.

KEY to fig. 4-16:

1. Field terminal
2. Output terminal
3. Ground
4. Regulator terminal
5. Lockwasher and bolt
6. Mounting bracket
7. Adjusting brace

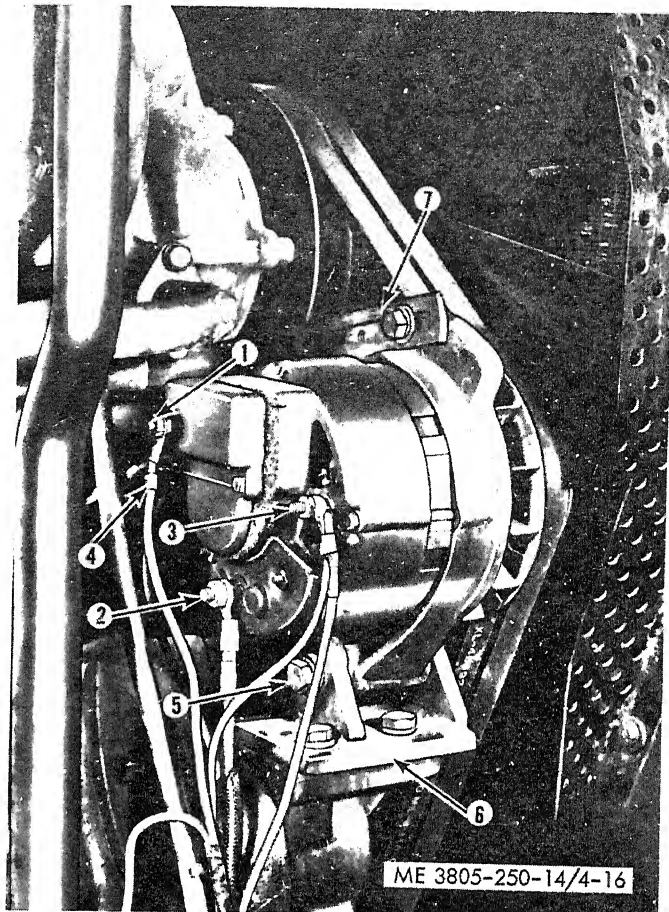


Figure 4-16. Alternator, removal and installation.

(3) Remove the pulley retaining nut and lockwasher, and place the pulley in a soft-jawed vise.

(4) Tap the alternator shaft sharply with a mallet to loosen and remove the pulley, pulley spacer, fan, fan spacer and key from the shaft.

c. *Installation.*

**Warning:** Make sure that the master switch is off and the battery cables are disconnected.

(1) Install the alternator by reversing the removal procedure.

(2) Adjust the belts (para 4-27).

(3) Connect the battery cables.

d. *Testing.*

(1) The following equipment is needed to test the alternator.

(a) D.C. Voltmeter, 0-40 volt scale.

(b) D.C. Ammeter, 0-10 amp scale and 0-100 amp scale.

(c) Field Rheostat, 0-50 ohms resistance, 50 watt capacity.

(d) Carbon Pile, 0-600 ampere load, knob controlled.



(2) Test for shorted diodes as follows:

(a) Remove the output lead from the

alternator output terminal and connect the system as shown in figure 4-17.

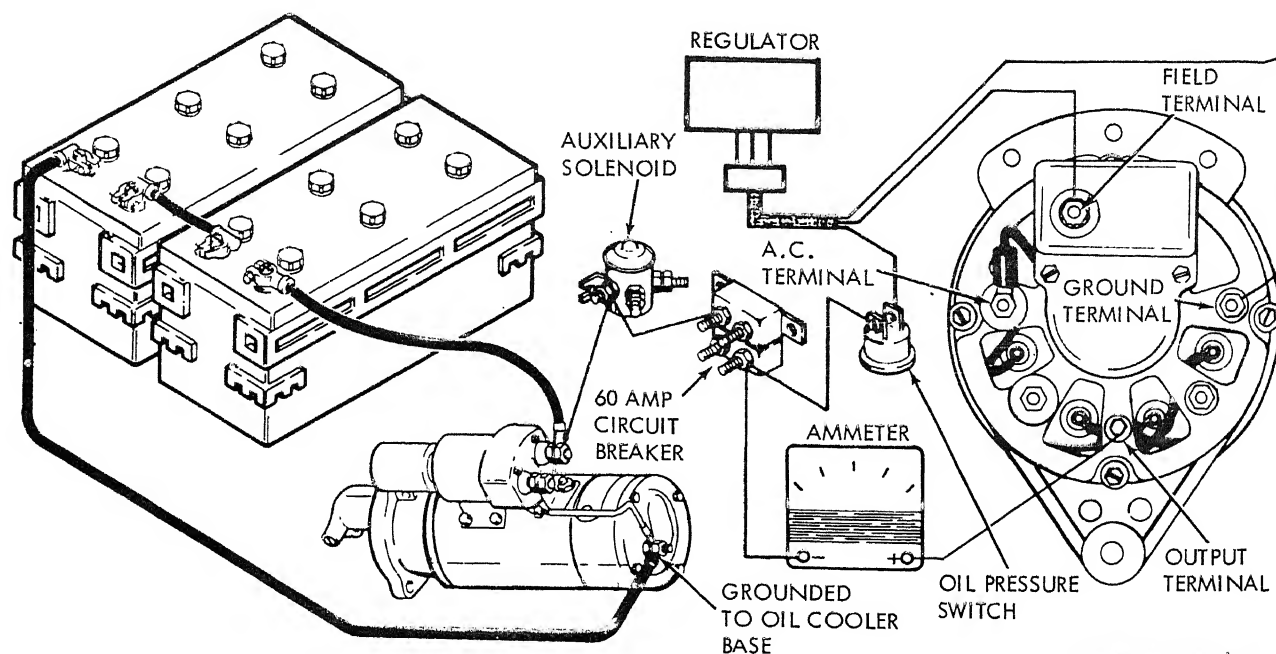


Figure 4-17. Diode test setup.

(b) Set the ammeter on the 0-100 amp scale. Connect the voltmeter positive lead to the alternator AC terminal and the negative lead to the alternator ground terminal. The voltmeter should read zero. If the voltmeter reads above zero, one or more positive rectifier diodes are shorted.

(c) Connect the voltmeter positive lead to the alternator output terminal and the negative lead to a negative diode lead. The voltmeter should read

zero. If the voltmeter reads above zero, one or more negative rectifier diodes are shorted.

(d) The ammeter should read zero during this test.

(3) Perform the field circuit test as follows:

(a) Turn the carbon pile control to the off position and connect the leads to the battery terminals as shown in figure 4-18.

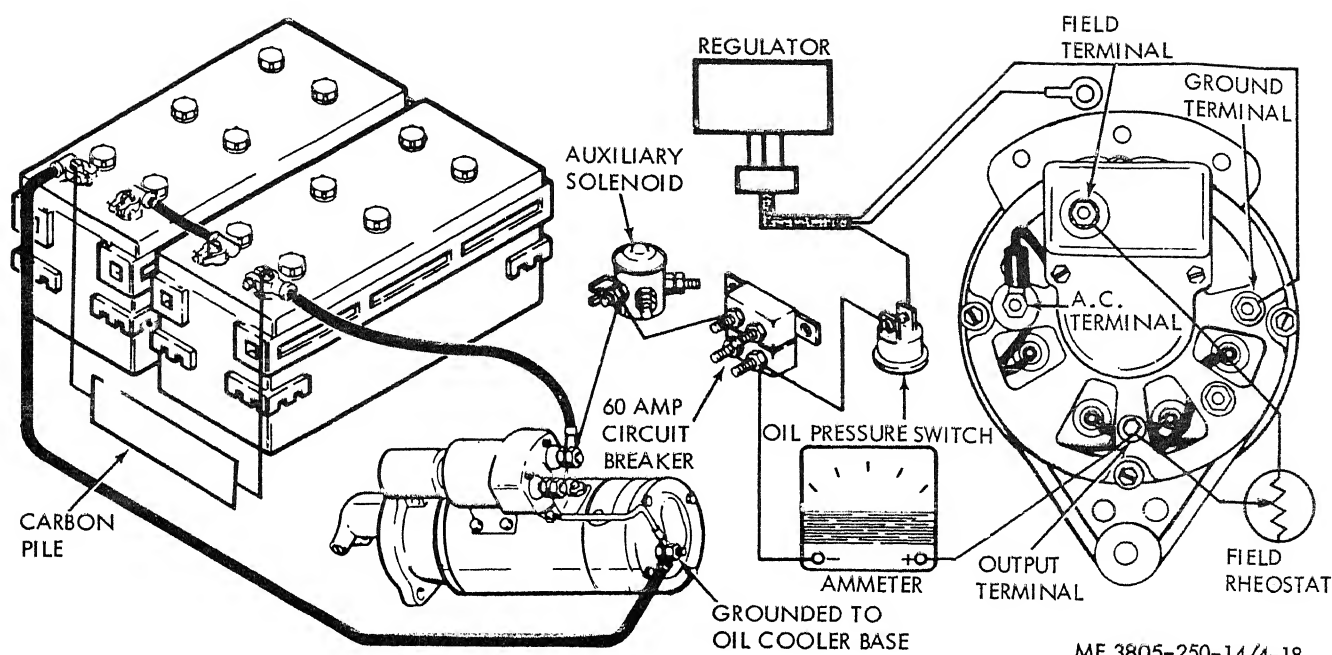


Figure 4-18. Field circuit test setup.

(b) Remove the field lead from the alternator field terminal.

**Caution:** Tape the eyeler on the field terminal wire. Grounding will damage the alternator.

(c) Set the rheostat control knob in the maximum resistance position. Connect one lead to the alternator field terminal and the other lead to the alternator output terminal.

(d) Connect the voltmeter positive lead to the alternator field terminal and the negative lead to the alternator ground terminal.

(e) Set the ammeter to read on the 0-10 amp scale.

(f) Slowly reduce the field rheostat resistance to zero, noting the ammeter reading. If

the reading exceeds 3.5 amps, stop the test and check for defective rotor.

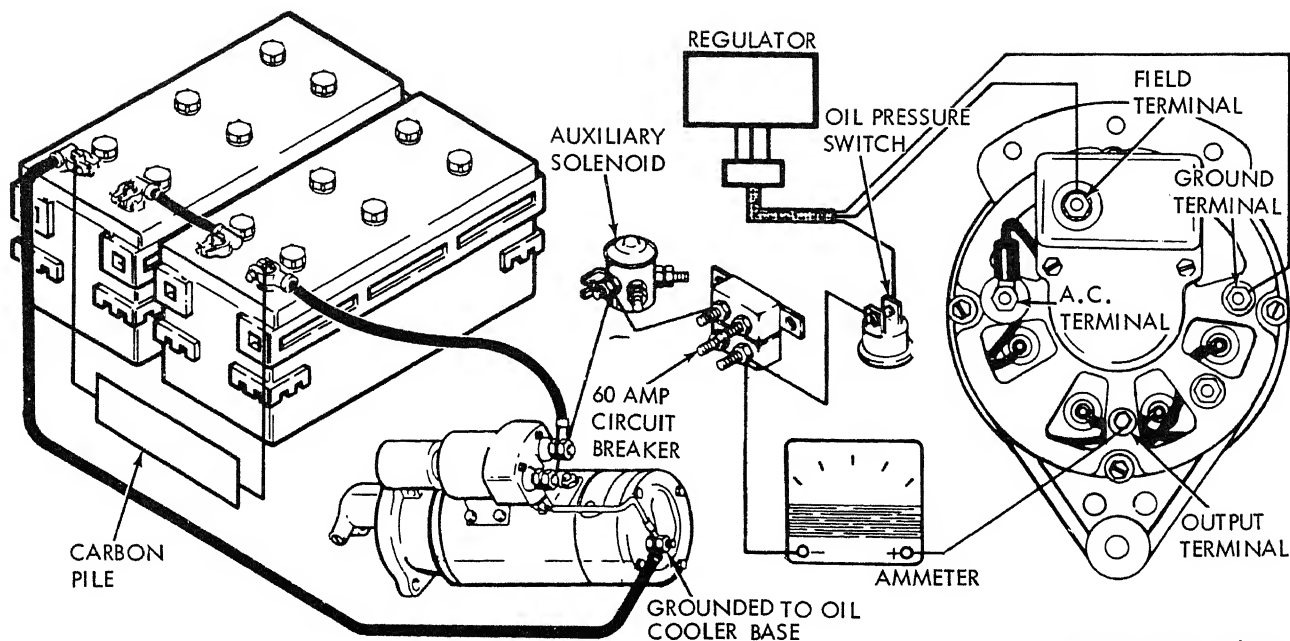
(g) Slowly apply the carbon pile load to the battery until the voltmeter reads 20.0 volts. The ammeter should read between 1.28 and 1.88 amps. Turn the carbon pile off.

*Note.* If the carbon pile is left on, batteries will discharge.

(h) If current is less than 1.28 amps, check for poor brush connections or poor soldered connections in the slip ring.

(i) Remove the field rheostat, and reconnect the field wire to the alternator field terminal. Set the ammeter on the 0-100 amp scale.

(4) Arrange the circuit as shown in figure 4-19 and perform the alternator output test as follows:



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Figure 4-19. Alternator output test setup.

(a) Connect the voltmeter positive lead to the alternator output terminal and the negative lead to the alternator ground terminal.

(b) Start the engine and run at high idle. Adjust the carbon pile to produce a 10-amp reading on the ammeter. Allow the engine to run a few minutes to stabilize the temperature.

(c) Adjust the carbon pile to obtain the highest alternator current output. Current output should not be less than 30.0 amperes and the voltage should be between 25.0 and 28.0 volts. Replace or repair the alternator if it does not produce the required output. Disconnect the carbon pile.

#### 4-31. Alternator Regulator

a. *General.* The alternator regulator, located on the back side of the left hood vertical support, controls the alternator output by regulating the current flow to the field of the alternator.

##### b. Removal.

- (1) Remove the side engine panel.
- (2) Remove bolts securing the vertical support to the hood and frame, and rotate the support 180 degrees.
- (3) Remove three bolts and lockwashers securing the regulator (fig. 4-20) to its mounting bracket and disconnect electrical leads. Remove the regulator from the loader.

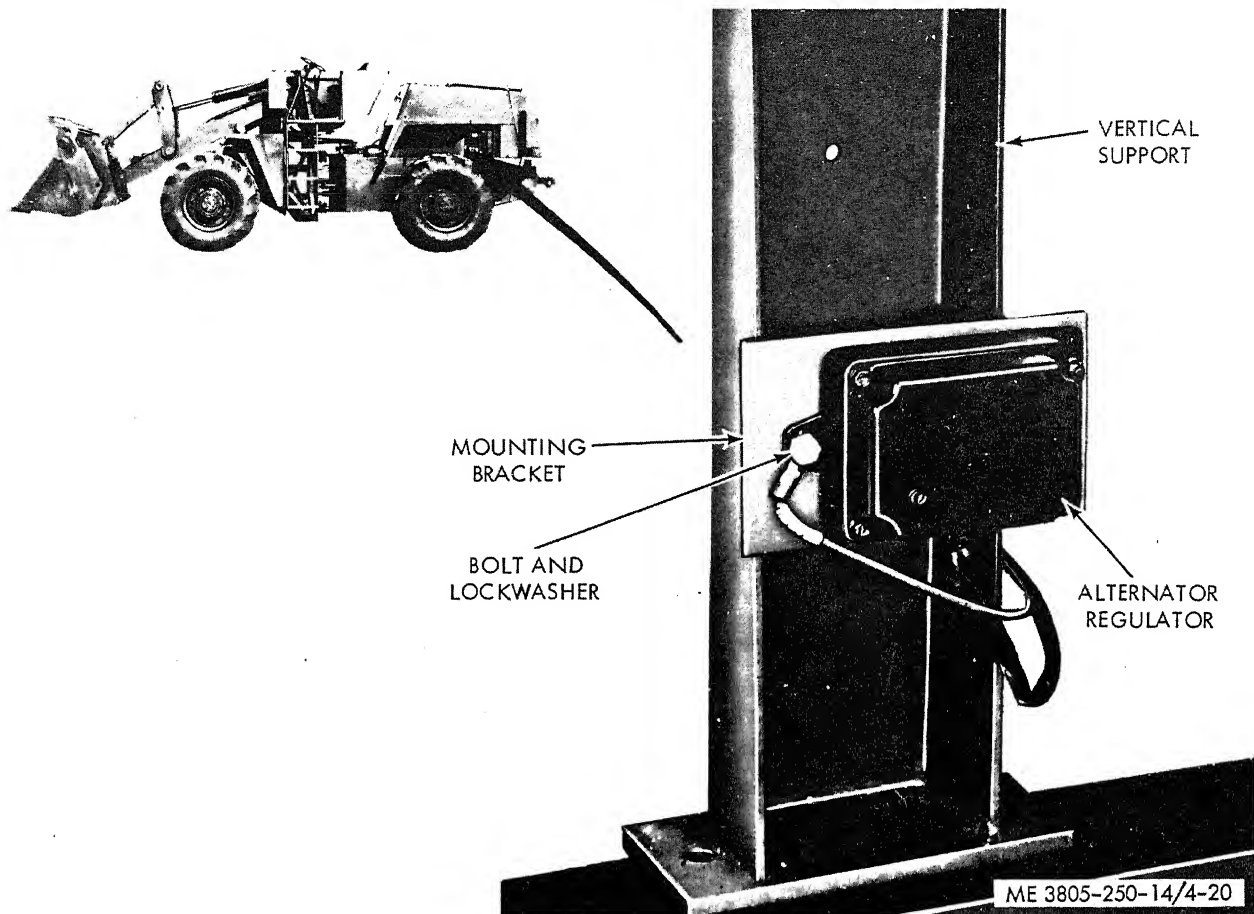


Figure 4-20. Alternator regulator, removal and installation.

*c. Installation.*

(1) Position the regulator on its mounting bracket and secure with three nuts, bolts, and lockwashers (fig. 4-20). Connect electrical leads.

(2) Rotate the vertical support into position and fasten to frame and hood.

(3) Install the side engine panel.

*c. Testing.*

(1) The following equipment is required for

testing the alternator regulator.

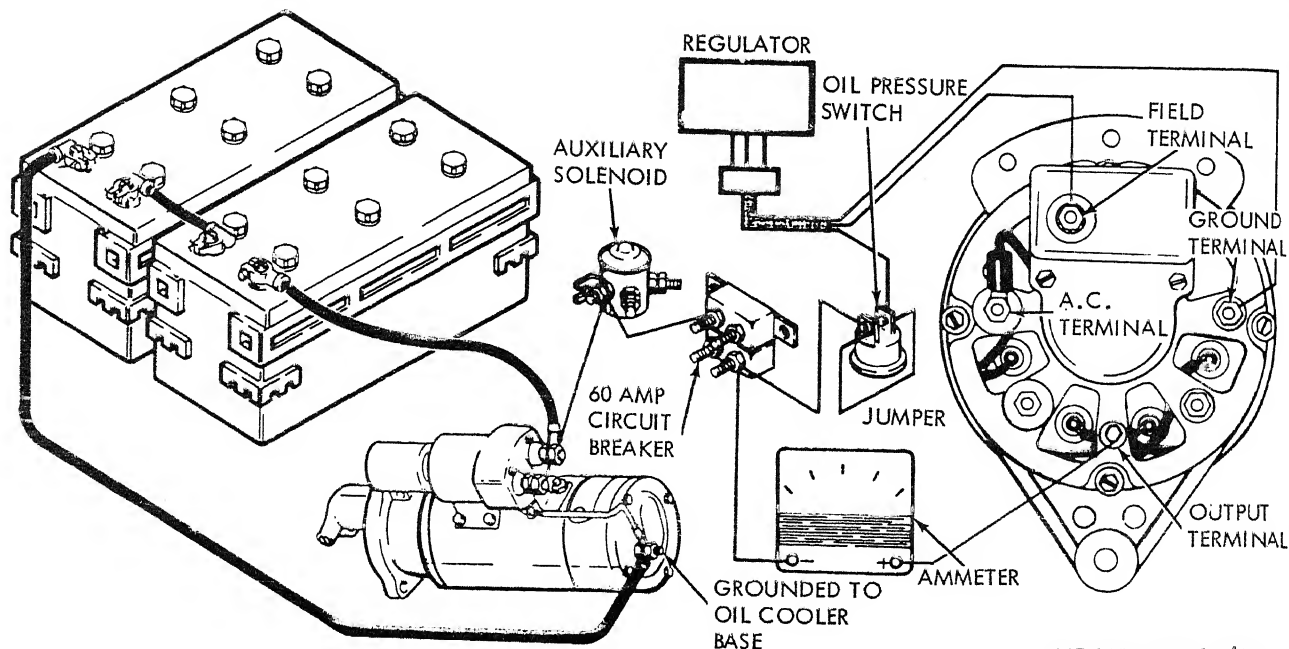
(a) D.C. Voltmeter, 0-40 volt scale.

(b) D.C. Ammeter, 0-100 amp scale.

(c)  $\frac{1}{4}$  ohm, 25 watt resistor.

(2) Perform the regulator load circuit test as follows:

(a) With the engine shut off, place a jumper wire across the oil pressure switch terminals and set up as illustrated in figure 4-21.



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Figure 4-21. Load circuit test setup.

(b) Connect the voltmeter positive lead to the alternator output terminal and the negative lead to the alternator ground terminal. Note the voltmeter reading.

(c) Connect the voltmeter positive lead to the alternator field terminal and again note the voltmeter reading.

(d) The difference between the readings taken in steps (b) and (c) should be 0.9 to 1.5 volts.

If the difference falls outside these boundaries, the regulator is defective and must be replaced.

(e) Remove the jumper wire from the oil pressure switch.

(3) Perform the regulator setting test as follows:

(a) Connect a  $\frac{1}{4}$  ohm, 25 watt resistor between the alternator output terminal and the ammeter positive lead (fig. 4-22).

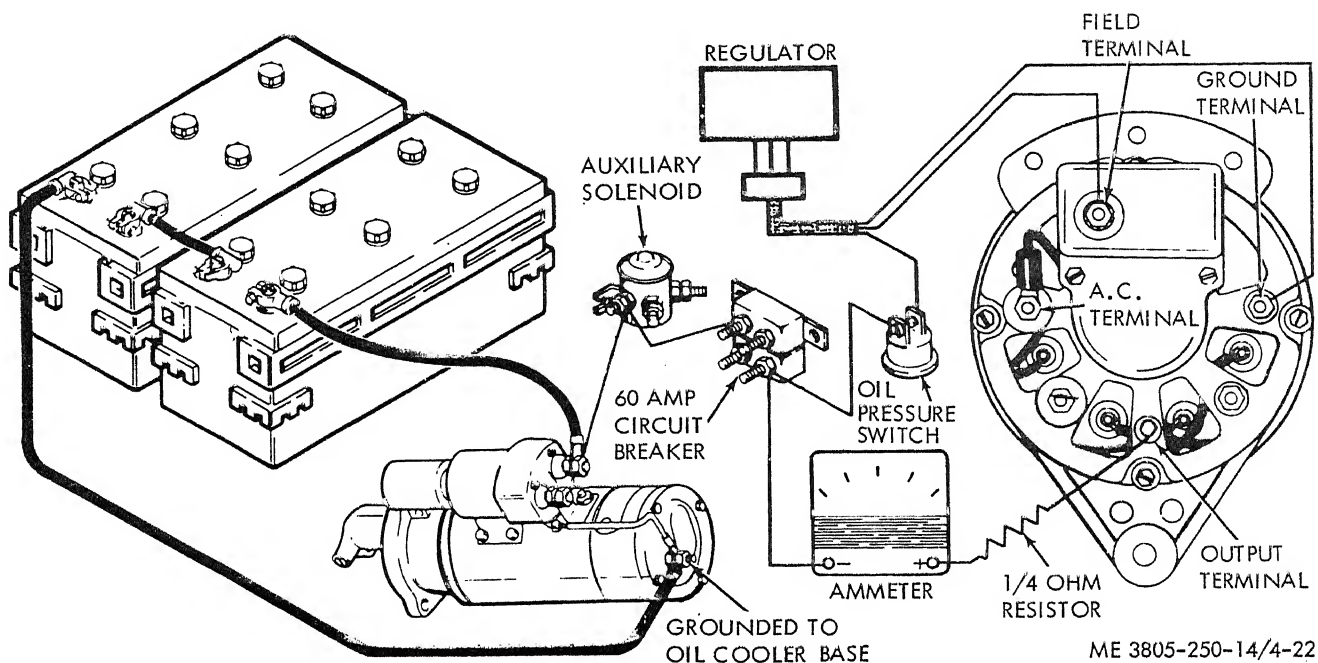


Figure 4-22. Regulator setting test setup.

(b) Connect the voltmeter positive lead to the alternator output terminal and the negative lead to the alternator ground terminal.

(c) Start the engine and run at high idle for a few minutes to stabilize component temperatures.

(d) Check that the ammeter indicates less than 10 amps and the voltmeter reads between 28.0 and 28.8 volts.

(e) If voltage readings do not meet requirements, adjust the regulator (subpara f).

(f) If the voltage cannot be corrected by adjusting the regulator, check for excessive resistance in the regulator ground circuit or replace the regulator.

#### d. Adjustment.

(1) Raise or lower the output voltage by 6 volts by placing an adjusting strap (fig. 4-23) across two "HI" screws to raise voltage or across the two "LO" screws to lower the voltage.

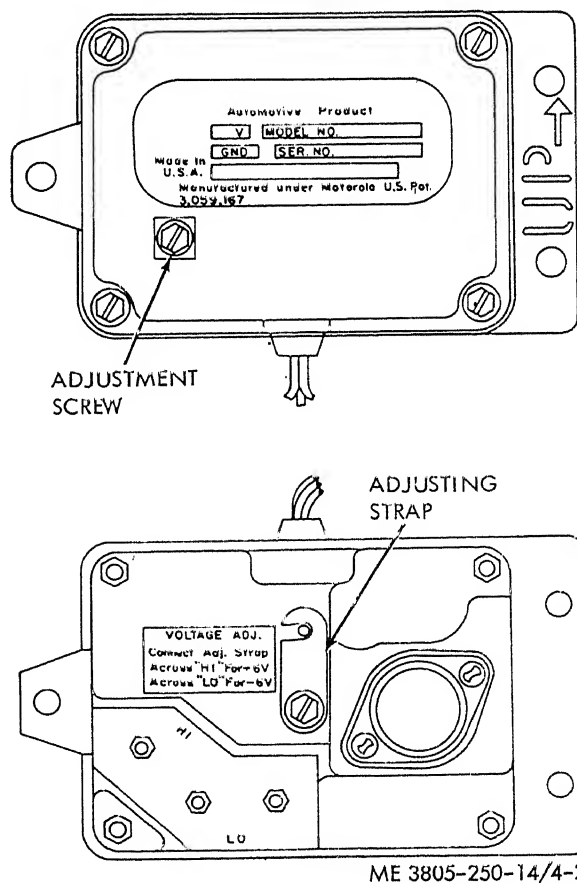


Figure 4-23. Regulator adjustment.

(2) Make fine adjustments of output voltage by means of the adjustment screw (fig. 4-23) as follows:

(a) Connect a 0 to 50 volt dc voltmeter to the battery and a 0 to 20 amp dc ammeter in series with the alternator output.

(b) Start the engine and operate at fast idle (1200 to 1500 rpm). Check engine speed with a tachometer. Switch on the lights so that the ammeter reads 10 to 15 amperes. Run the engine until the voltmeter stabilizes.

(c) Remove the access screw and gasket and use a screwdriver to rotate the adjusting screw counterclockwise to reduce voltage and clockwise to increase voltage. Do not attempt to turn more than one-half turn in either direction.

**Warning: The alternator regulator is electrically charged. Do not touch anything but the regulator with the screwdriver.**

(d) Observe the voltmeter and set the voltage to the desired amount. Install the access screw and gasket and shut off the engine.

#### 4-32. Starter Motor

a. *General.* The starter motor, mounted on the left side of the engine, is an over-running clutch type motor. A solenoid-operated lever pivots to move the clutch drive gear into engagement with the flywheel. After engagement, the solenoid switch completes the circuit, rotating the motor.

##### b. Removal.

**Warning: Make sure the master switch is off and the battery cables are disconnected. Disconnect ground cable first.**

(1) Disconnect the cables and lead wires from the solenoid (fig. 4-24) by removing two nuts on the solenoid and the terminal nut on the starter.

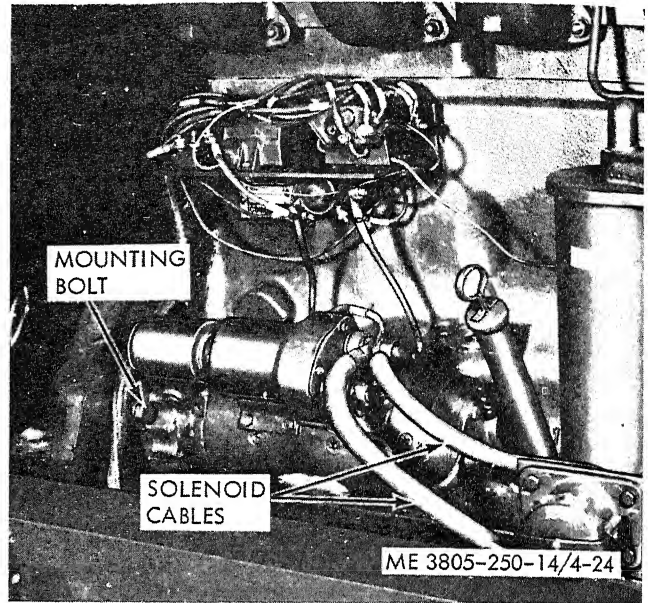


Figure 4-24. Starter motor, removal and installation.

(2) Remove three bolts and lockwashers securing the starter in position, and remove the starter from the engine.

##### c. Installation.

**Warning: Make sure the master switch is off and the battery cables are disconnected.**

(1) Position the starter (fig. 4-24) to the engine and secure with three bolts and lockwashers.

(2) Connect the electrical leads to the starter and solenoid and secure with nuts.

(3) Reconnect battery cables.

##### d. Solenoid Replacement.

(1) Remove two nuts (fig. 4-25) securing the leads to the solenoid. Tag the leads for proper installation.



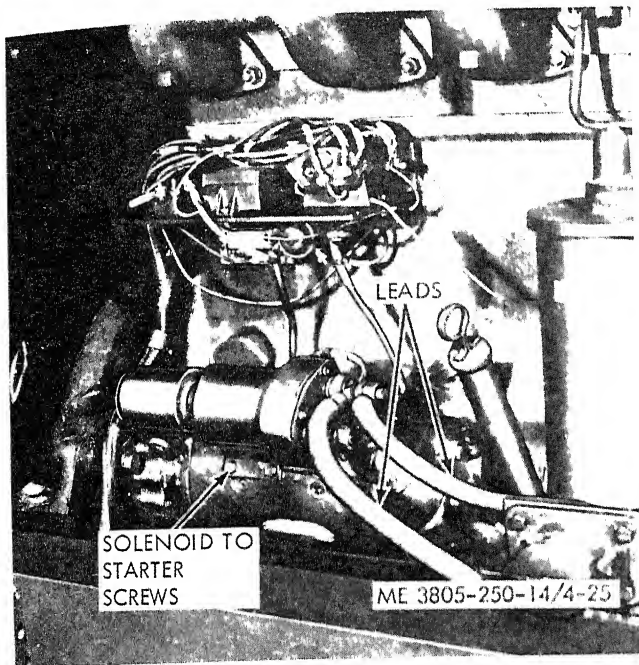


Figure 4-25. Solenoid replacement.

(2) Remove the four screws securing the solenoid to the starter and remove the solenoid.

(3) Position a new or repaired solenoid on the starter, using care not to damage the rubber boot. Secure with four screws.

(4) Connect connector and leads to the solenoid and secure with two nuts.

#### 4-33. Instrument Panel.

*a. General.* The instrument panel mounts the gages and switches required for operating the loader.

##### *b. Removal.*

(1) Disconnect the battery cables. Open the drain cocks on the air reservoir to relieve air pressure.

(2) Remove three bolts, washers, lockwashers, and nuts (fig. 4-26) holding each panel half in place.

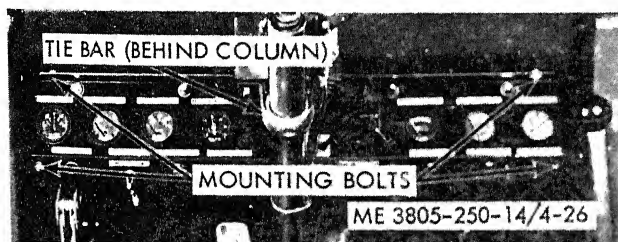


Figure 4-26. Instrument panel, removal and installation.

(3) Rotate the panel halves to expose the backs of the gages and disconnect tubes and wires leading to the instruments. Tag wires and tubes as they are removed to ensure proper installation.

(4) Remove the remaining bolt, nut, washer and lockwasher securing the panel halves to the tie bar. Remove the panel from the loader.

(5) Remove the instruments and switches from the panel as described in paragraph 4-63.

##### *c. Installation.*

(1) Install the instruments and switches on the panel as described in paragraph 4-63.

(2) Install the panel section in the loader in reverse order of removal.

##### *d. Gages, Switches, Lamps and Lights.*

(1) *Replacement.* Refer to paragraph 4-63.

(2) *Repair.* Repair is limited to broken wiring and faulty connections. Replace defective bulbs. Replace defective 75-ohm resistors on the engine oil pressure gage, engine coolant temperature gage and converter temperature gage.

##### *e. Wiring.*

(1) *Replacement.* The instrument panel wiring harness may be replaced by disconnecting terminals from the controls and indicators and disconnecting from chassis wiring. Install new or repaired harness by reversing the removal procedure.

(2) *Repair.* Harness wiring repair consists of resoldering broken terminals, replacing faulty insulation, repairing shorted terminals, and replacing broken wires and connections.

#### 4-34. Batteries

*a. General.* Two twelve-volt batteries, mounted between the radiator and grille, store power for the loader unit. The batteries are connected in series to provide a 24-volt output to the starter and other electrical equipment. A battery box with cover protects the batteries.

*b. Testing and Charging.* Refer to TM 9-6140-200-15 Maintenance of Storage Batteries, Lead-Acid Type. Use Battery Tester 6625-647-4112 (13ST5) to determine the condition of a battery.

*c. Service.* Servicing the batteries consists of maintaining the electrolyte level at three-fourths inch above the separators. Add distilled water (or clean water when distilled water is not available) to maintain the electrolyte level. After adding water in freezing weather, operate the engine for at least thirty minutes to thoroughly mix the electrolyte.

##### *d. Replacement.* Refer to figure 4-27.

(1) Open the rear grille to attain access to the batteries. Remove the cover from the battery box.

(2) With the master switch off, disconnect the battery cables. Always disconnect the ground cable first.

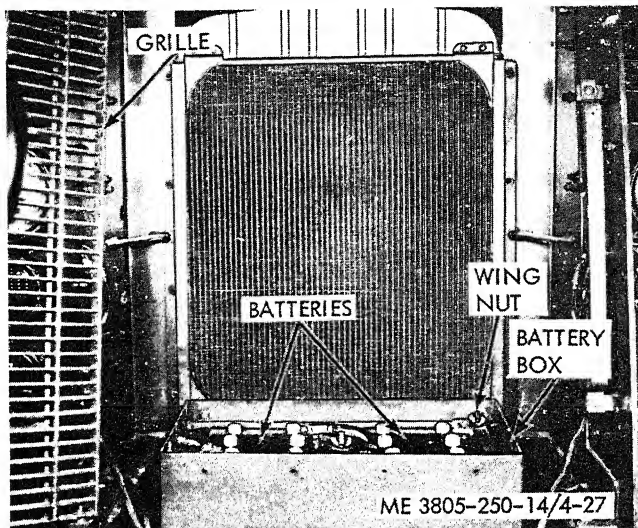


Figure 4-27. Batteries.

(3) Remove five wing nuts securing the batteries in place, and remove the batteries.

(4) To install batteries, position in the battery box and secure with wing nuts.

(5) Connect the battery cables and install the cover on the battery box. Close the rear grille.

*e. Battery Box and Cables.*

(1) *Replacement.* Replace cables by unscrewing the terminal connectors and installing new cables. Replace the battery box by removing four bolts which secure the box to the frame and installing a new or repaired box.

(2) *Repair.* Repair battery cables by replacing broken insulation collars or replacing broken wires in the cable harness. Replace cracked insulation. Clean corroded terminals with a water solution of ammonia or sodium bicarbonate and wash with clean water. Repair boxes by welding torn seams. Remove any corrosion with a water solution of ammonia or sodium bicarbonate and wash clean.

#### 4-35. Auxiliary Solenoid

*a. General.* The auxiliary solenoid, mounted on the electrical components bracket above the starter, closes a high amperage circuit to the starter solenoid. When the master switch is on and the neutral start switch on the transmission linkage is closed, current flows to the auxiliary solenoid and actuates the plunger. When the neutral start switch is opened, the solenoid opens the circuit to the starter.

*b. Removal.*

(1) Place the master switch in the off position and disconnect the battery ground cable.

(2) Tag and disconnect all wiring from the auxiliary solenoid terminals (fig. 4-28).

(3) Remove two mounting screws and washers, and remove the solenoid from the electrical components bracket.

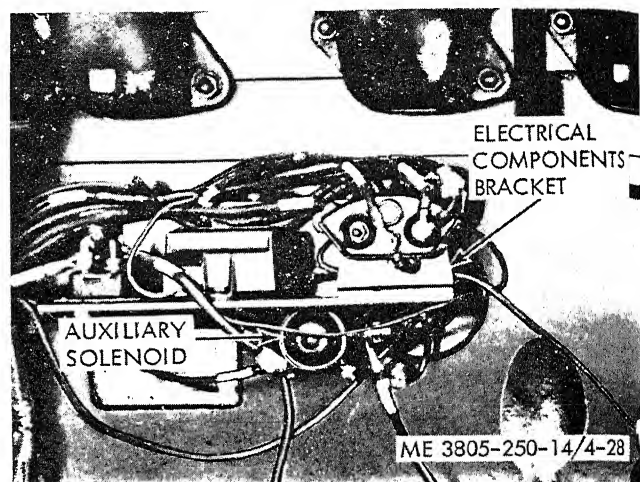


Figure 4-28. Auxiliary solenoid, removal and installation.

*c. Installation.*

(1) Install solenoid by reversing the removal process.

(2) Connect the battery ground cable.

(3) Start the engine and check the operation of the starter and solenoid.

#### 4-36. Exterior Lights

*a. General.* The loader exterior lighting system consists of one head light, three front flood lights, one front black-out light, two front park and turn lights, two rear floor lights, two rear black-out lights, and two stop, tail and signal lights. The head light and taillights, flood lights, and black-out lights are controlled by switches mounted on the instrument panel. The park and turn lights are controlled by a lever mounted on the steering column.

*b. Removal.* Refer to figure 4-29.

(1) Turn the master switch to the off position and disconnect battery ground cable.

(2) Disconnect wires from lights to be removed.

(3) To remove head light, remove nut and washer securing light to its mounting bracket.

(4) To remove front flood lights, remove nut and washer, and remove the light from its mounting bracket.

(5) To remove front park and turn lights remove two screws and lockwashers securing the light to the bracket.

(6) To remove front black-out lights, remove nut, washer, and bearing washer.

(7) To remove rear flood lights, remove nut and washer.

(8) To remove rear stop, tail, and signal lamp assembly, remove two screws and lockwashers.

(9) To remove rear black-out lights, remove screw and lockwasher.

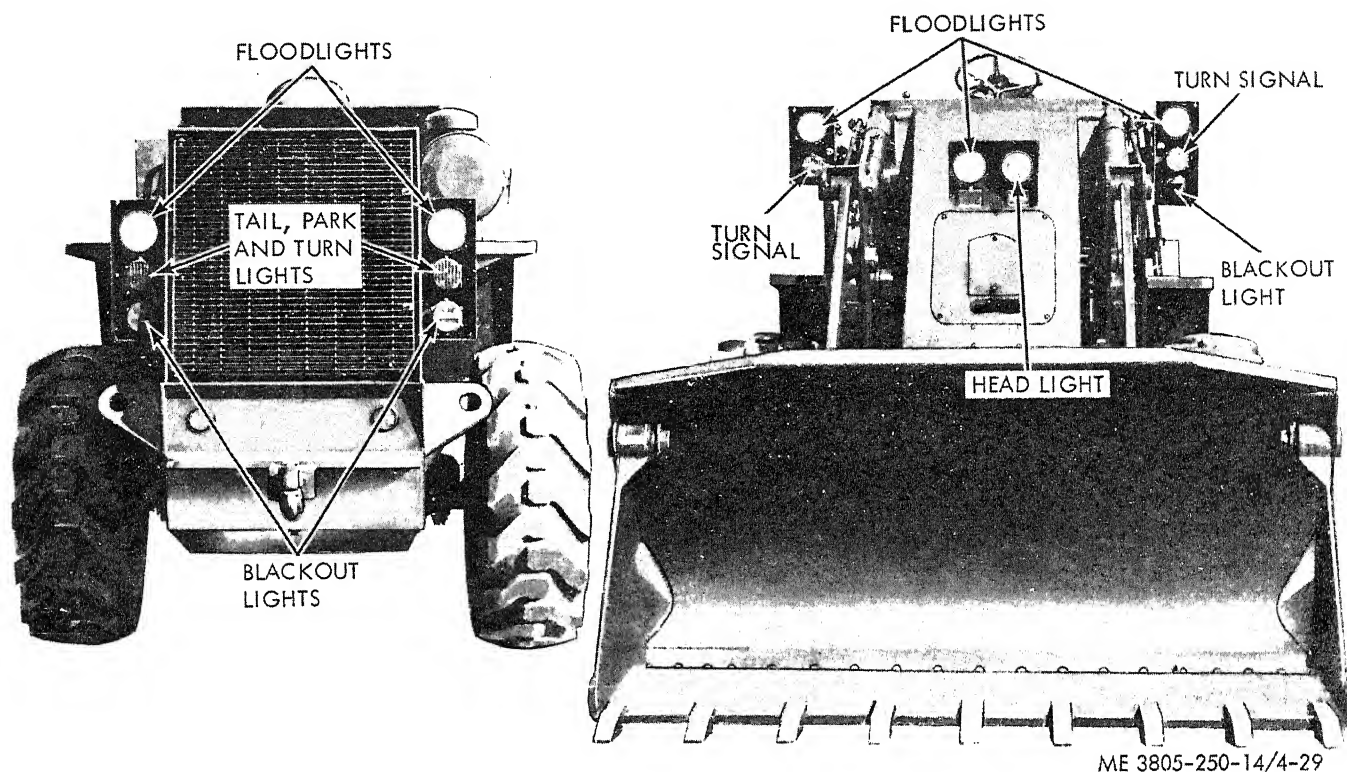


Figure 4-29. Loader exterior lights.

*c. Bulb Replacement.* To replace bulb, roll the rubber lip from the edge of the lens. Remove lens and install new bulb. Install lens and secure by rolling the rubber lip over the edge.

#### 4-37. Horn

*a. General.* The horn is air-operated and electrically controlled. Depressing the horn switch actuates the horn solenoid and opens the air valve, permitting air to enter the horn and sound a warning.

*b. Switch Replacement.* Replace a defective horn switch by removing the switch from the left side of the instrument panel, tagging and disconnecting wiring, and installing a new switch.

#### 4-38. Warning Devices

*a. General.* The loader warning devices consist of a low air pressure warning light and buzzer and a converter temperature warning buzzer and switch. When the system air pressure drops below the minimum acceptable level, the warning light on the instrument panel illuminates. When converter

temperature reaches 250° F, the buzzer sounds to warn the operator to stop the loader.

#### *b. Replacement.*

(1) Replace a defective air pressure warning light by removing the lens and unscrewing bulb from the instrument panel. Install a new bulb.

(2) Replace defective converter temperature switch by disconnecting wiring and removing the switch from the transmission housing. Install a new switch.

(3) Replace defective buzzer by disconnecting wiring and removing two screws, nuts, and lockwashers securing the buzzer to the back side of the instrument panel. Install a new buzzer.

#### 4-39. Wiring and Wiring Harness Repair

*a.* Repair broken, frayed, or cracked insulation.

*b.* Resolder or replace broken terminals.

*c.* Repair shorted connections.

*d.* Replace broken wires and connections.

*e.* Clean corroded terminals with abrasive cloth or replace as necessary.

## Section XIII. MAINTENANCE OF THE TRANSMISSION

### 4-40. Transmission Assembly

a. *General.* The transmission consists of a torque converter, planetary gear set, reverse gear set, and a direct drive clutch. Drive shafts extend from the front and rear of the housing and connect to the axle differentials. The transmission is capable of four forward and two reverse speeds.

b. *Inspection.* Inspect the transmission for loose bolts, oil leaks, linkage defects, and bent or damaged oil lines. Clean the transmission housing and linkage periodically. Lubricate the linkage.

#### c. Checking Oil Level.

##### (1) Cold check.

(a) Two oil level check plugs are located at the lower right front of the transmission housing (fig. 4-30). Before starting the engine, remove the upper plug. If oil flows from the plug opening, there is sufficient oil to permit starting the engine. If little or no oil flow is present, add oil until oil flows from the opening.

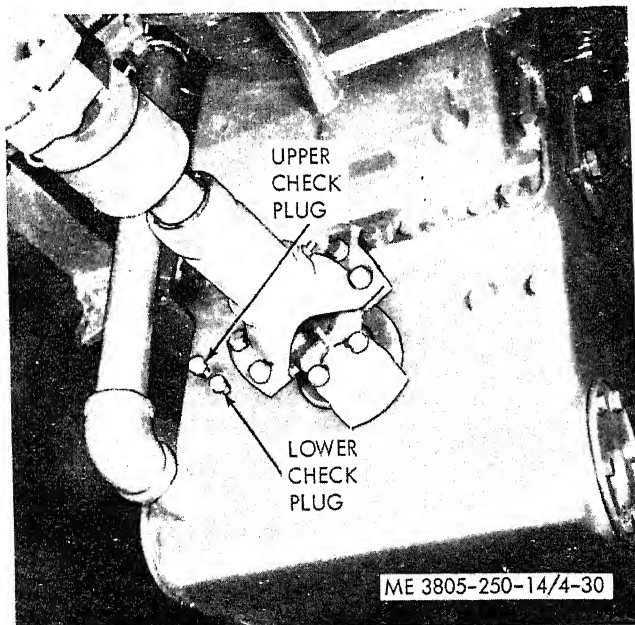


Figure 4-30. Transmission oil level check plugs.

(b) Start the engine and operate at idle to half throttle with the transmission in neutral. Operate for approximately 1 minute to charge the hydraulic system.

(c) With the engine running, add oil as necessary to bring the level to the lower check plug.

*Note.* An oil check made at lower engine rpm may result in low oil level at operating speeds. Thermal expansion will raise the oil level when the transmission oil reaches operating temperature.

(d) Perform the hot oil check.

(2) *Hot check.* Start the engine and run at idle to half throttle until the transmission reaches normal operating temperature (approximately 180° F). Idle the engine and slowly shift through all range positions to ensure that all parts of the system are filled with oil. Shift to neutral and operate the engine at idle or half throttle. Remove the upper oil level check plug. Add oil as necessary to bring the level to the plug opening.

*Note.* Foaming or spurting may indicate a false oil level. A true level is indicated by a steady trickle of oil flowing from the check plug hole. The transmission may be operated safely as long as the oil is above the level of the lower check plug.

#### d. Changing Oil.

(1) *Draining.* With the transmission at operating temperature (180° F), remove the drain plug at the lower left rear of the transmission housing (fig. 4-31). Remove the oil filter (subpara e) and service the oil strainer (subpara f). Allow the oil to drain for 30 minutes. Install the oil strainer and a new filter element.

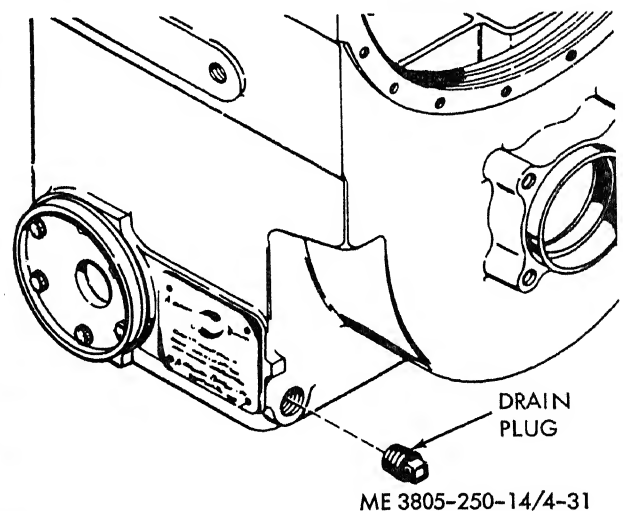


Figure 4-31. Draining transmission oil.

(2) *Refilling.* Install the drain plug and add 4 quarts of transmission fluid according to the Lubrication Order. Perform the hot check (subpara c) and add oil as necessary.

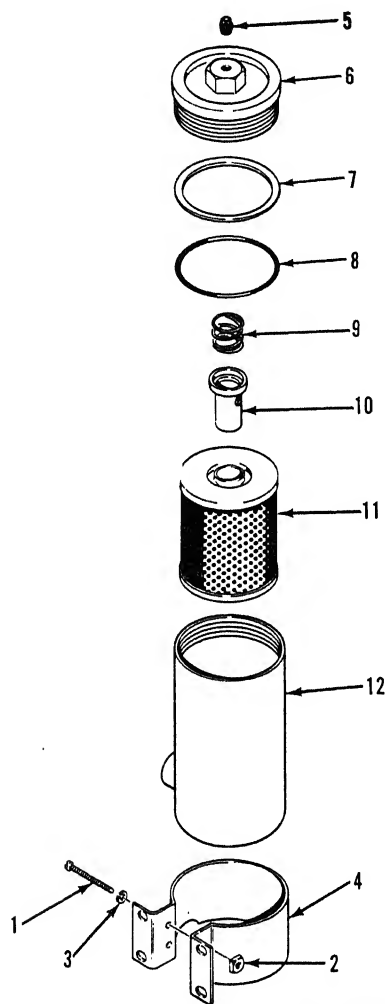
#### e. Transmission Oil Filter Service.

(1) Disconnect the oil lines to the transmission oil filter (fig. 4-32). Cap or plug openings.

(2) Remove four screws, nuts and lockwashers securing the filter mounting bracket to the transmission. Remove the filter and bracket as an assembly.

(3) Remove two screws (1, fig. 4-32), nuts (2) and lockwashers (3) securing the filter to the mounting bracket (4). Remove the mounting bracket.

(4) Remove the pipe plug (5) and unscrew the end cap (6). Remove backup ring (7), preformed packing (8), spring (9), relief valve (10) and filter element (11) from housing (12).



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1. Screw
2. Nut
3. Lockwasher
4. Mounting bracket
5. Pipe plug
6. End cap
7. Backup ring
8. Preformed packing
9. Spring
10. Relief valve
11. Filter element
12. Housing

Figure 4-32. Transmission oil filter service.

(5) Clean all components in solvent and wipe dry.

(6) Install a new element (11) and reassemble the filter. Tighten the end cap (6) to 20 to 35 pound feet.

(7) Install the filter assembly and mounting bracket to the transmission.

(8) Check transmission oil level and add as necessary.

#### f. Strainer Service.

(1) Start the engine and allow to run until the transmission temperature gage reads approximately 180° F. Stop the engine.

(2) Remove the drain plug (fig. 4-33) and allow the oil to drain from the transmission.

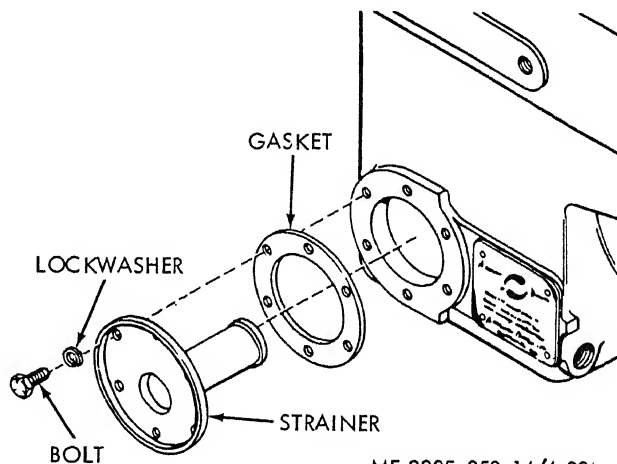
(3) Service the transmission oil filter (subpara e).

(4) Remove screws and lockwashers securing the strainer to the transmission housing. Discard the gasket.

(5) Clean the strainer in solvent and dry with compressed air.

(6) Install the strainer and new gasket on the transmission housing. Check that the inside end of the strainer slips over the end of the oil pickup tube in the sump.

(7) Fill the transmission with oil (subpara d).



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Figure 4-33. Transmission strainer service

g. Breather Service. Clean the area around the breather (fig. 4-34) and remove from transmission housing. Clean the breather by agitating in mineral spirits or solvent. Dry thoroughly with compressed air before installing. Always use a wrench of the proper size to remove or install the breather.



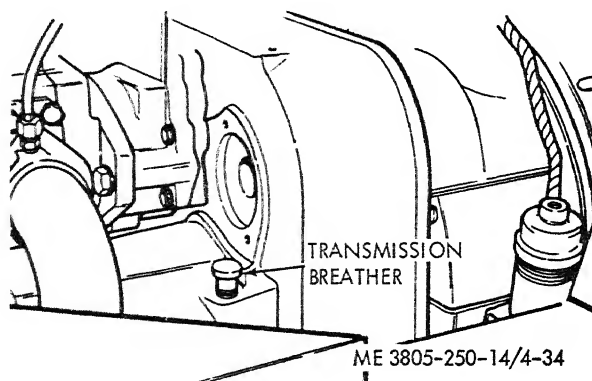


Figure 4-34. Transmission breather service.

## Section XIV. MAINTENANCE OF THE AXLES

### 4-41. Axle Assemblies

a. *General.* Each axle consists of an axle housing, differential, and two planetaries. The differentials are driven by drive shafts from the transmission and in turn, drive the axle drive shafts connected to the planetaries in each wheel.

b. *Planetary Service.* Move the loader until the arrow on the planetary cover (fig. 4-35) points to the ground. Remove the oil level check plug. Oil should run out the opening. If the level is low, add oil as necessary. Refer to the Lubrication Order for the correct lubricant. Planetary capacity is 6½ quarts.

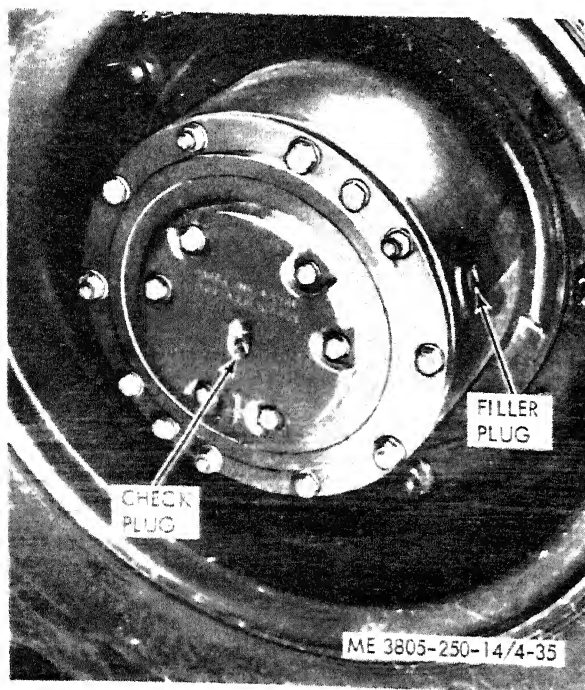


Figure 4-35. Planetary service.

### h. Hose, Lines, and Fittings Replacement.

(1) Remove the drain plug (fig. 4-31) and allow oil to drain from the transmission.

(2) Clean all oil lines and fittings before removal. If several lines are to be replaced, tag lines to ensure proper installation.

(3) Disconnect clamps or attaching hardware and remove line which is to be replaced.

(4) Install a new line by reversing the removal procedure.

c. *Differential Service.* Remove the differential filler plug (fig. 4-36). Oil should run out of opening. If level is low, add oil as necessary. Refer to the Lubrication Order for the correct lubricant. Differential capacity is 13 quarts.

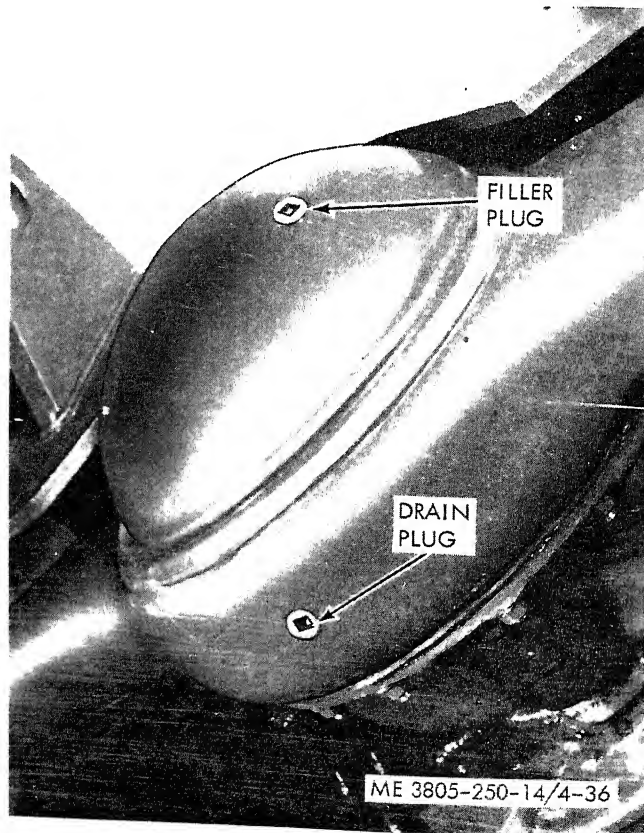


Figure 4-36. Differential service.

### d. Breather Replacement.

(1) Clean the area around the axle breather and remove the breather from the housing.

(2) Clean the breather in solvent and install in the axle. If necessary, install a new breather.

*e. Planetary Cover Replacement.*

(1) Remove bolts securing the planetary cover (fig. 4-37) to the planetary spider. Discard the gasket.

(2) Install cover and a new gasket by reversing the removal procedure.

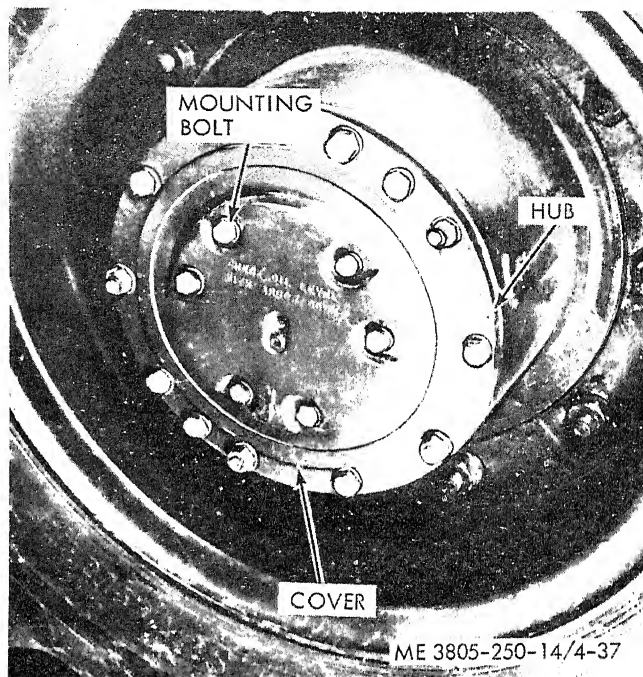


Figure 4-37. Planetary cover.

## Section XV. MAINTENANCE OF THE BRAKES

### 4-42. Parking Brake

*a. General.* The parking brake, mounted on the front of the transmission, is mechanical with internal expanding shoes. A lever in the cab controls brake action. When the lever is pulled up, the linkage engages the linings with the drum.

*b. Adjustment.*

(1) Adjust parking brake lever as follows:

(a) Place the lever in the off (down) position.

(b) Rotate the knurled knob on the end of the brake lever to obtain a dimension of 1.1 inches as shown in figure 4-38.

(c) Loosen the locknut at the turnbuckle and adjust the cable to obtain a force requirement of 80 to 90 pounds to raise the brake lever.

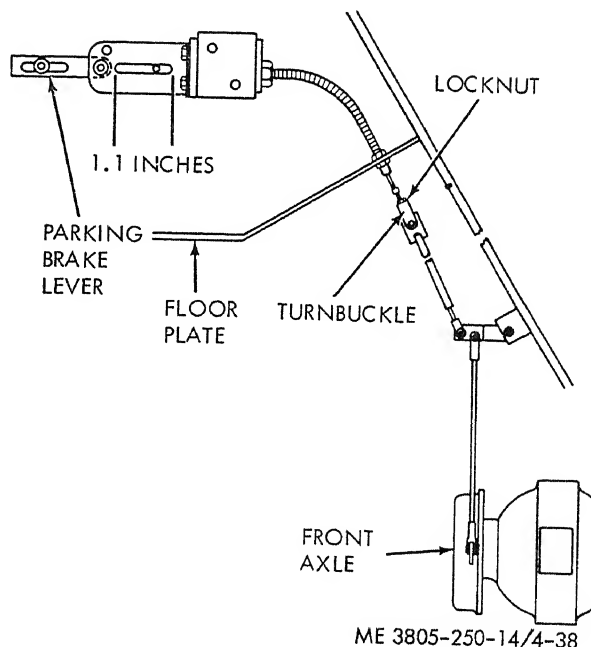


Figure 4-38. Parking brake lever adjustment.

(2) Adjust the brake linkage as follows:

(a) Loosen the locknut (fig. 4-39) and remove the yoke pin.

(b) Turn the yoke to lengthen or shorten the effective length of the cable.



(c) Install the yoke pin and tighten locknut. Check for clearance between the lining and drum when the handle is released.

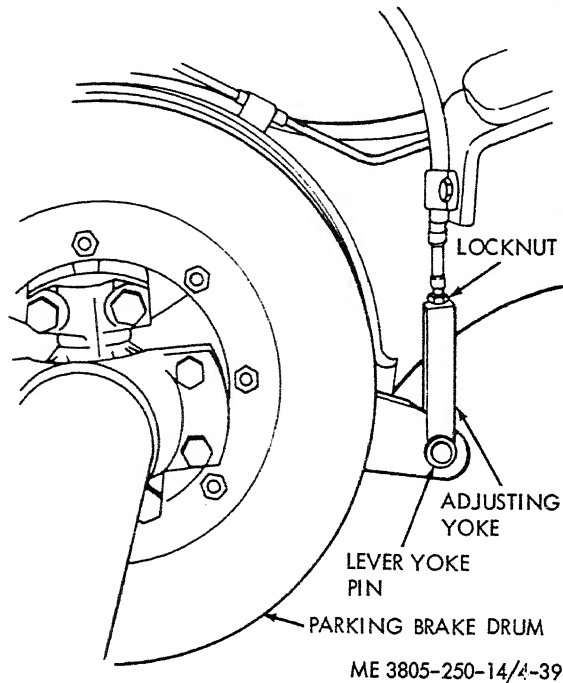


Figure 4-39. Parking brake linkage adjustment.

#### 4-43. Wheel Brakes

a. *General.* The wheel brakes operate by a combination of hydraulic and air pressure. A brake is mounted on each of the wheels. A wheel cylinder, operated by hydraulic pressure, forces the linings against the drums to stop the loader. The linings are retracted from the drums through spring action when hydraulic pressure is released.

##### b. Adjustment.

(1) Turn the lower brake adjusting wheel (fig. 4-40) until the lining drags on the drum when the drum is rotated.

(2) Turn the upper adjusting wheel until the lining drags on the drum.

(3) Alternately turn each adjusting wheel until the drum cannot be rotated.

(4) Back off the adjusting wheels alternately until the lining no longer drags on the drum.

(5) Bleed the brake hydraulic system (subpara c) to remove any air.

(6) Check the brake adjustment and repeat steps (1) through (4) as necessary.

(7) Adjust the opposite brake.

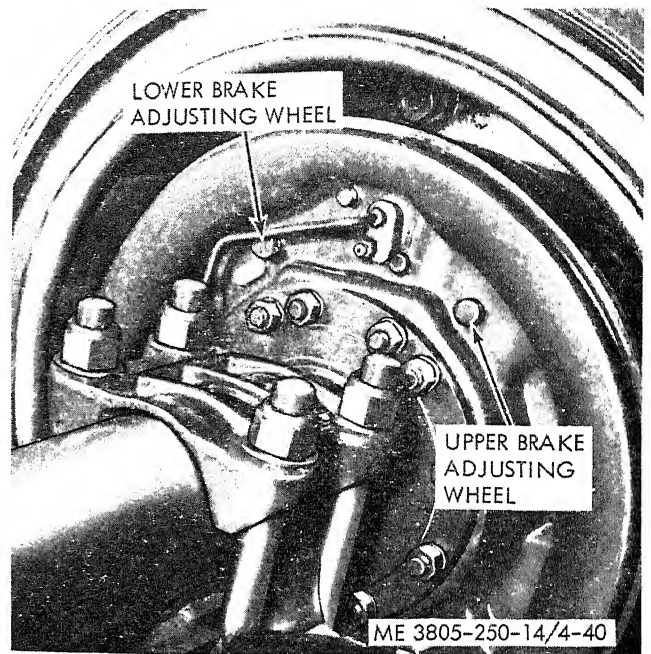


Figure 4-40. Wheel brake adjustment.

c. *Bleeding.* When the front or rear brake system has been disconnected, that system must be bled at the wheel cylinders. Use a pressurized bleed tank and proceed as follows:

(1) Fill and bleed the pressure tank according to manufacturer's directions

(2) Connect a line from the pressure tank to the hydraulic cylinder filler opening and open the valve on the pressure tank.

(3) Loosen the bleeder valve (fig. 4-41) on the wheel cylinder and observe brake fluid flow. When air bubbles no longer appear, close bleeder valve.

(4) Repeat step 3 for opposite wheel.

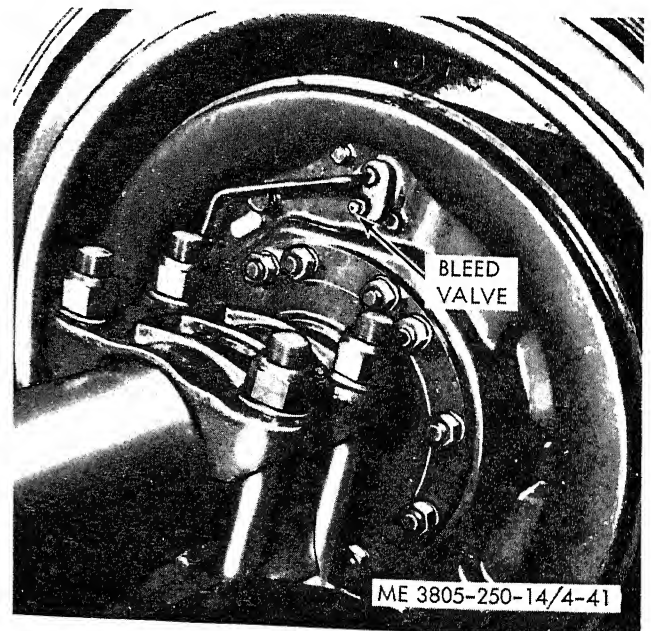


Figure 4-41. Bleeding brakes.

#### 4-44. Hydraulic Brake Actuator

**a. General.** The hydraulic brake actuator consists of a hydraulic cylinder and an air chamber. Compressed air from the reservoir acts on the piston and push rod assembly in the air chamber. The push rod then acts on the push rod in the hydraulic cylinder increasing pressure in the hydraulic brake system. As the pressure increases, the pistons in the wheel cylinders move outward, forcing the brake shoes against the drum.

##### **b. Inspection.**

- (1) Inspect fittings for leakage.
- (2) Check mounting bolts for security.

##### **c. Service (fig. 4-42).**

(1) Clean the area around the brake actuator filler plug and remove the plug. Fluid level should be  $\frac{1}{2}$  inch from the filler opening.

(2) Replenish fluid if necessary. Refer to the Lubrication Order for the correct lubricant. Capacity is 1 pint.

(3) Install the filler plug and tighten securely.

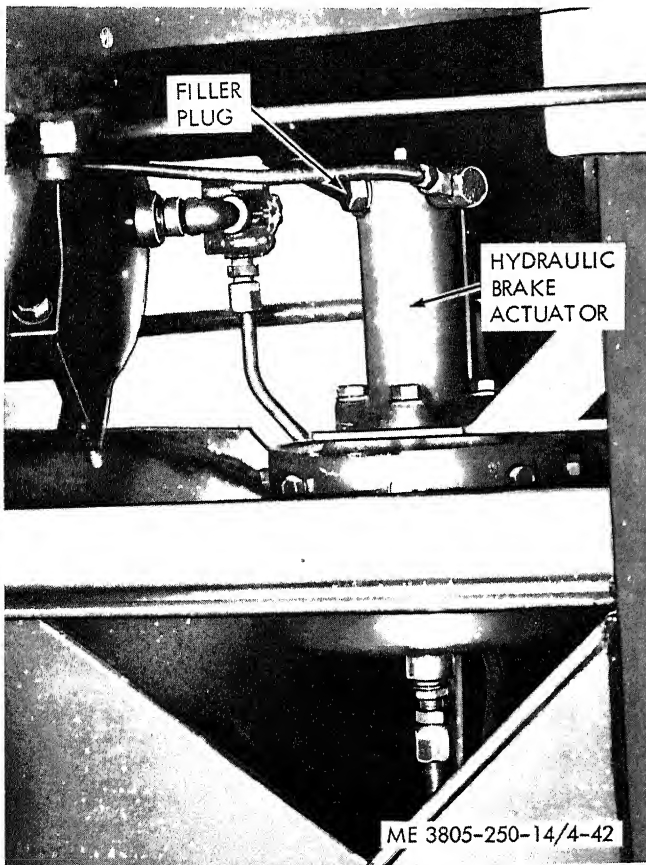


Figure 4-42. Brake actuator service.

#### 4-45. Brake Air Valve

**a. General.** The brake air valve directs pressurized air to operate the brakes whenever the brake pedal is depressed.

##### **b. Removal.**

- (1) Block the wheels or apply the parking brake.
- (2) Open the drain cock on the main air reservoir.
- (3) Clean the air valve and surrounding area to remove dirt and grease.
- (4) Disconnect air lines from the valve (fig. 4-43). Cap or plug ports and fittings to prevent entry of dirt.
- (5) Remove three bolts, washers and lock-washers securing the valve to the cab floor, and remove from loader.

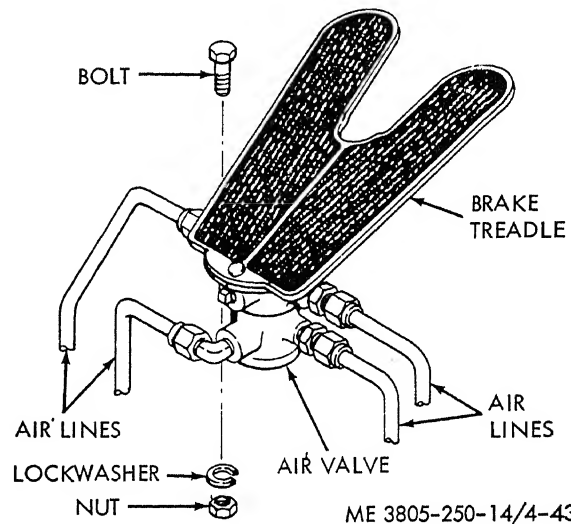


Figure 4-43. Brake air valve, removal and installation.

##### **c. Installation.**

- (1) Install the valve by reversing the removal procedure.
- (2) Close the air reservoir drain cock and start the engine to pressurize the system. Check for leaks.

##### **d. Testing.**

**Note.** Perform the following tests whenever the valve has been rebuilt or to determine the serviceability of an old valve.

##### **(1) Operating test.**

(a) Install an accurate air pressure gage capable of reading up to 150 psi in the delivery line from the brake control valve.

(b) Depress the treadle to several positions between the fully released and fully applied positions. The gage should indicate pressure variations in proportion to the amount of treadle movement.

(c) Depress the treadle to the fully applied position. The test gage indication should agree with the air pressure of the reservoir.

(d) Release the treadle. The test gage should fall to zero.

(2) *Leakage test.*

(a) With the treadle fully released, apply a soap solution to the exhaust port of the brake control valve. Check for leaks.

(b) Fully depress and hold the treadle, and apply a soap solution to the exhaust port of the valve. Check for leaks.

(c) If leakage is evident, check valve for defective O-rings. If necessary, replace valve.

## Section XVI. MAINTENANCE OF THE WHEELS

### 4-46. Tires

#### a. Removal.

(1) Park the loader on a firm level surface with the bucket resting on the ground. Install the safety locking bar. Engage the parking brake and block the wheels which are not to be removed.

(2) Use a suitable jack or hoist to raise the wheel at least 2 inches off the ground.

(3) Remove the cap, valve, and adapter (fig. 4-44) and deflate the tire.

**Caution: Do not allow the lock ring to fly out of the wheel.**

(4) Force a tire tool between the lock ring and the flange, and pry the lock ring from the flange.

(5) Remove the preformed packing from the wheel, and remove the tire.

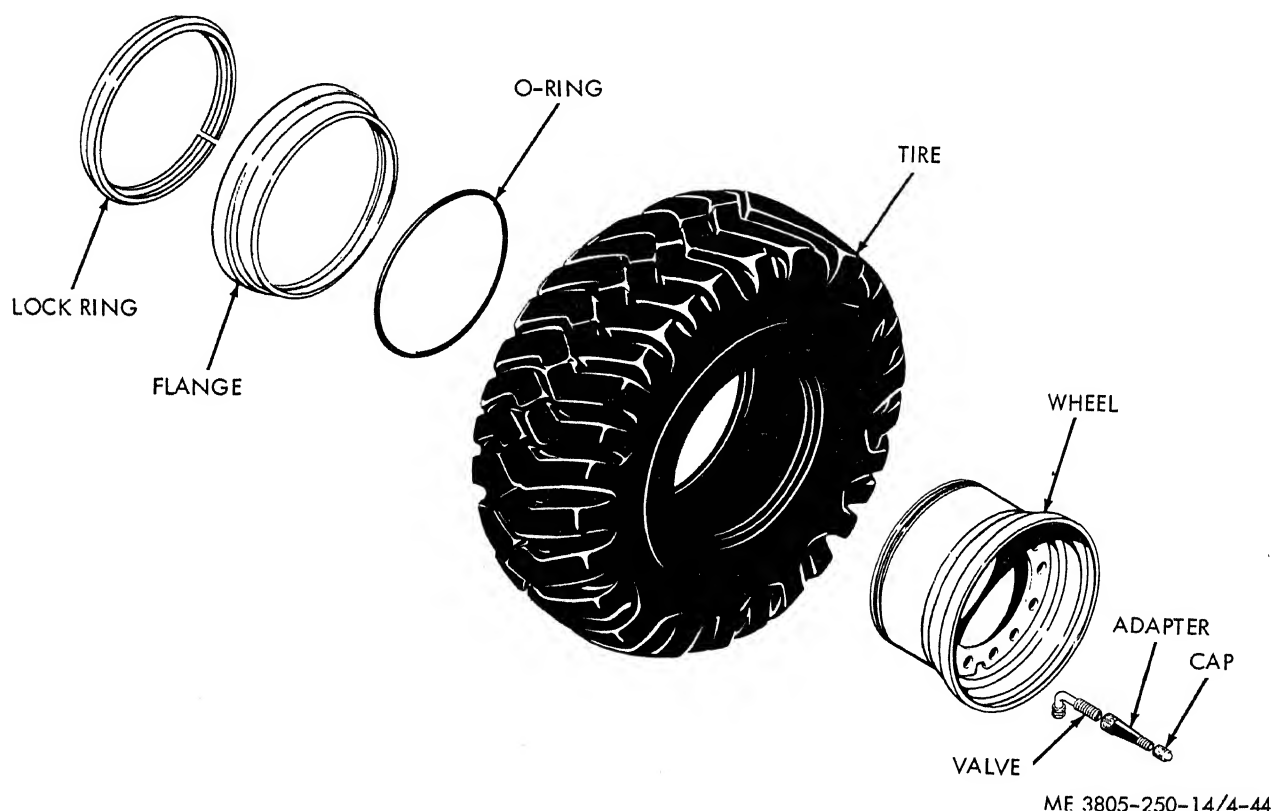


Figure 4-44. Wheel and tire, exploded view.

#### b. Cleaning and Inspection.

(1) Remove all dirt from the tire with scrub brush.

(2) Inspect the exterior for cuts and abrasions. Remove all foreign material from the threads.

(3) Inspect the interior of the tire for sharp objects, cuts, abrasions, and protrusions.

(4) Replace all unserviceable parts.

#### c. Installation.

(1) Place the tire on the wheel (fig. 4-44).

(2) Lubricate the preformed packing and install in the groove in the rim.

(3) Slide the flange onto the rim, using care not to damage the preformed packing. Install the lock ring, tapping into position with a soft hammer.

**Warning:** Install safety cables around the tire and through the rim, or use an inflation cage to avoid possible injury to personnel during tire inflation.

(4) Inflate the tire with the valve and adapter for an initial rapid air flow. When the tire seals, install the valve and adapter and inflate the tire to 60 psi to seat. Deflate tire to 45 psi and install the cap.

## Section XVI. MAINTENANCE OF THE STEERING SYSTEM

### 4-47. Steering Gear Assembly

*a. General.* The steering gear assembly, mounted beneath the cab floor, incorporates the steering control valve and the steering column. The function of the steering gear is to direct the flow of hydraulic oil to the steering cylinders as determined by the position of the steering wheel.

*b. Service.* Check the steering gear lubricant every 500 hours by removing the check plug on the side of the steering gear box. Oil should flow out the opening. If level is low, fill through the plug in the floor of the operator's compartment. Refer to the Lubrication Order for the correct lubricant.

### 4-48. Steering Hose, Lines and Fittings Replacement

*a.* Replace hose by removing from the ends of the steering cylinders and disconnecting from the steering tee.

*b.* Disconnect lines at the relief valve and hydraulic reservoir.

*c.* Disconnect lines at the steering control valve and the steering tee.

*d.* Remove elbows, preformed packings, clamps, and tubes.

## Section XVIII. MAINTENANCE OF THE FRAME

### 4-49. Ladder

*a. General.* A ladder, used for entry into the operator's compartment, is mounted on the left side of the frame. Hand rails are incorporated in the ladder.

*b. Removal.* The ladder is secured to the frame at four points. Remove the attaching hardware and remove the ladder.

### 4-50. Pintle

*a. General.* The towing pintle is a hook mounted on the rear of the frame and used as an attachment point for towing.

*b. Removal.* To remove the pintle, remove the cotter pin and large castle nut securing the pintle to the frame.

*c. Service.* Lubricate the pintle with automotive grease.

*d. Repair.*

(1) Inspect the pintle for distortion or damage.

(2) Inspect threads for thread damage.

(3) Inspect lock and hardware for defects.

Replace damaged components.

## Section XIX. MAINTENANCE OF THE BODY

### 4-51. Hood and Fenders Replacement

*a.* To remove the fender, support the fender and remove bolt, two washers, lockwasher, and nut securing the fender to the frame in ten places. Lift the fender over the wheel and away from the loader.

*b.* Before removing the hood, remove the exhaust pipe (para 4-22) and air cleaner (para 4-21). On each side of the loader, remove bolt, two washers, lockwashers, and nut securing the hood to the frame at six places. On top of the hood, remove bolt, two washers, lockwasher and nut at eleven places. Remove the right half of the hood first and

lift over the radiator cap and away from the loader. Remove the left half of the hood.

### 4-52. Floor Plate Replacement

*a.* Remove the seat (para 4-53) and tool box.

*b.* Disconnect the foot throttle linkage below the floorboard.

*c.* Open the drain cock on the air reservoir and disconnect air lines from the brake control valve and the air line from the horn to the horn valve. Cap or plug openings.

*d.* Remove four bolts, washers, lockwashers, and nuts securing the floor plate to the frame. Guide the plate from the loader.

e. Install floor plate by reversing the removal procedure.

#### 4-53. Seat

a. *General.* The seat, placed for easy access to controls and a clear view of all instruments, provides a comfortable position for the operator. The seat is adjustable both vertically and horizontally.

b. *Replacement* (fig. 4-45).

(1) To remove seat assembly, remove bolt, two washers, lockwasher, and nut securing the seat frame to the floor plate support in four places on each side of the seat.

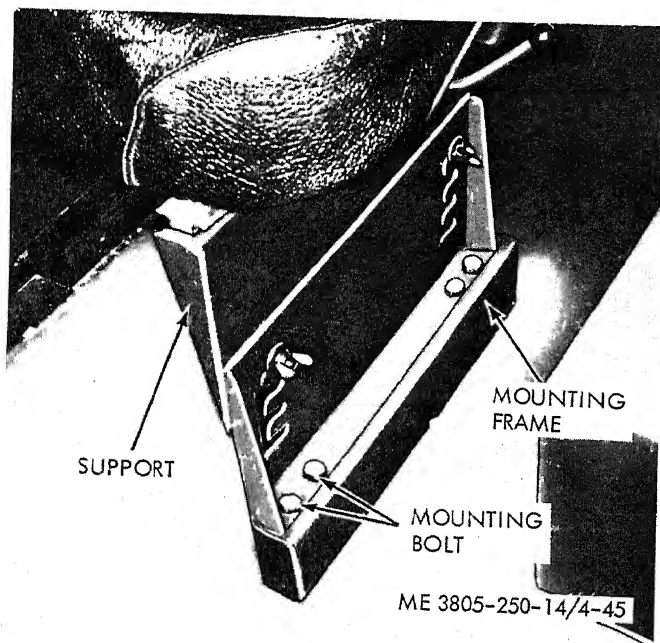


Figure 4-45. Seat removal and installation.

(2) To remove the seat shell and cushions, remove bolt, two washers, lockwasher, and nut securing the seat shell to the seat riser at two places on each side of the seat.

(3) To remove backrest, remove five capscrews and washers. To remove seat cushion, remove two capscrews and washers.

c. *Repair.* Repair torn cover on cushion or backrest with a cloth mending tape. Inspect seat riser for dents and bends and straighten. Straighten bent seat adjusting paths. Replace bent vertical adjustment bolts.

#### 4-54. Radiator Grille

a. *General.* The grille forms the rear end of the body. It is secured to the frame on one side and bolted closed on the other so that it may be swung open for easy access for maintenance.

b. *Replacement.*

(1) Remove two bolts, washers, lockwashers, and nuts securing the right side of the grille closed.

(2) Open the grille. Remove grille pivot bolts from the top and bottom of the left side of the grille. Remove from loader.

(3) To install grille, reverse the removal procedure.

### Section XX. MAINTENANCE OF ACCESSORY ITEMS

#### 4-55. Data Plates

a. *General.* Identification, data and instruction plates are mounted on the loader to identify components, give information for basic maintenance, and give warnings in danger areas.

b. *Replacement.* Plates are secured to the frame, instrument panel, or loader component with two or four aluminum eyelets. When a plate is no longer legible and must be replaced, remove the eyelets and install the new plate with new eyelets.

### Section XXI. MAINTENANCE OF HYDRAULIC AND HYDRAULIC LIFT COMPONENTS

#### 4-56. Depressurizing Hydraulic System

To depressurize the hydraulic system, close the air valve at the hydraulic reservoir and slowly withdraw the dipstick.

#### 4-57. Cleaning Hydraulic System

a. Install a 20 micron "flow pac" filter in the

suction line from the hydraulic oil tank to the pump.

b. Remove the outlet filter from the tank.

c. Sweep the inside bottom of the tank with a magnet to pick up metal particles.

d. Run the engine at half throttle for a minimum of eight minutes to flush the system.



e. After the first three minutes of flushing, actuate the loader control valve 10 complete cycles.

f. After flushing, again sweep the inside bottom of the tank with a magnet.

g. Install the out let filter and a clean magnet.

h. Remove the "flow pac" filter and reconnect hydraulic lines.

#### 4-58. Hydraulic Oil Cooler

a. *General.* The hydraulic oil cooler, mounted in the loader mid-section opening, prevents hydraulic oil from overheating. The cooler works in conjunction with the engine cooling system.

b. *Replacement (fig. 4-46).*

(1) Remove six bolts, nuts and lockwashers securing the cooler to the loader frame.

(2) Disconnect inlet and outlet lines to the hydraulic system and water cooling system. Cap or plug openings.

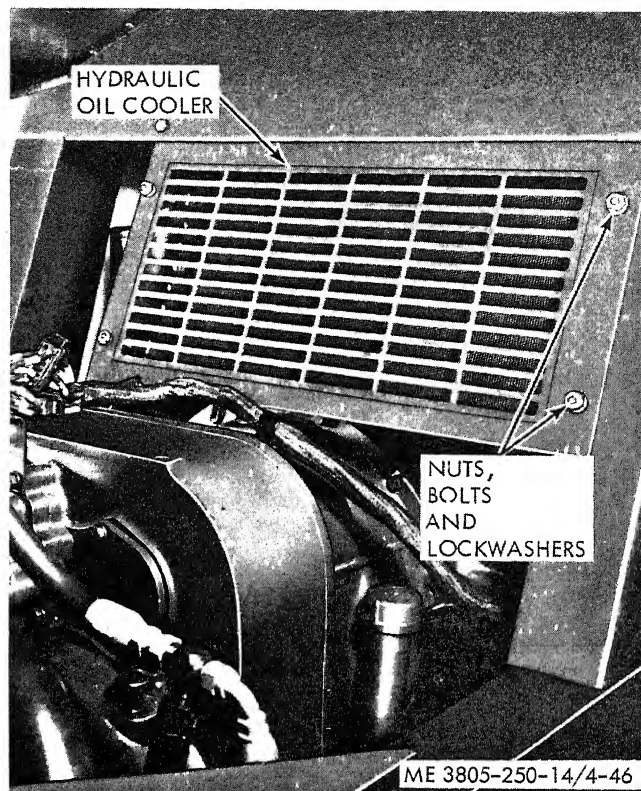


Figure 4-46. Hydraulic oil cooler, removal and installation.

(3) Remove the cooler from the loader.

(4) Install the cooler by reversing the removal procedure.

(5) Start the engine and check for leaks.

## Section XXII. MAINTENANCE OF MANUAL CONTROLS

#### 4-59. Bucket Control Linkage and Levers

a. *General.* Two levers, mounted in the operator's compartment, control the operation of the lift arms and bucket. The boom lever is linked to the lift spool of the loader control valve and operates the lift cylinders in four positions: raise, neutral, lower and float. The bucket lever is linked to the tilt and clam spools. Moving the lever forward dumps the bucket, moving back retracts the bucket, moving left opens the clam, and moving right closes the clam.

b. *Removal.* Refer to figure 4-47.

(1) Remove spool links (1, 2 and 3) as follows:

(a) Remove bolts (4) and lockwashers (5) and slip ball joints (6) from mountings. Remove locknuts (7).

(b) Disconnect ball joints (8) from loader control valve spools. Remove joints and locknuts (9).

(2) Remove bolts (10) and lockwashers (11) securing mounting frames (12 and 13) to the under side of the floorboard. Remove knobs (14) and lower the levers through the floorboard.

(3) Remove to a workbench. Remove cotter key (15), bolt (16) and lockwasher (17) and slide out bar (18).

(4) Remove bushings (19) and tube (20).

(5) Remove cotter keys (21) and pin (22) securing mount (23).

(6) Remove bolts (24) and lockwashers (25), and remove joints (26) and stud (27).

(7) Remove cotter key (28), bolt (29) and lockwasher (30) and slide out pin (31) from pivot linkage (32).

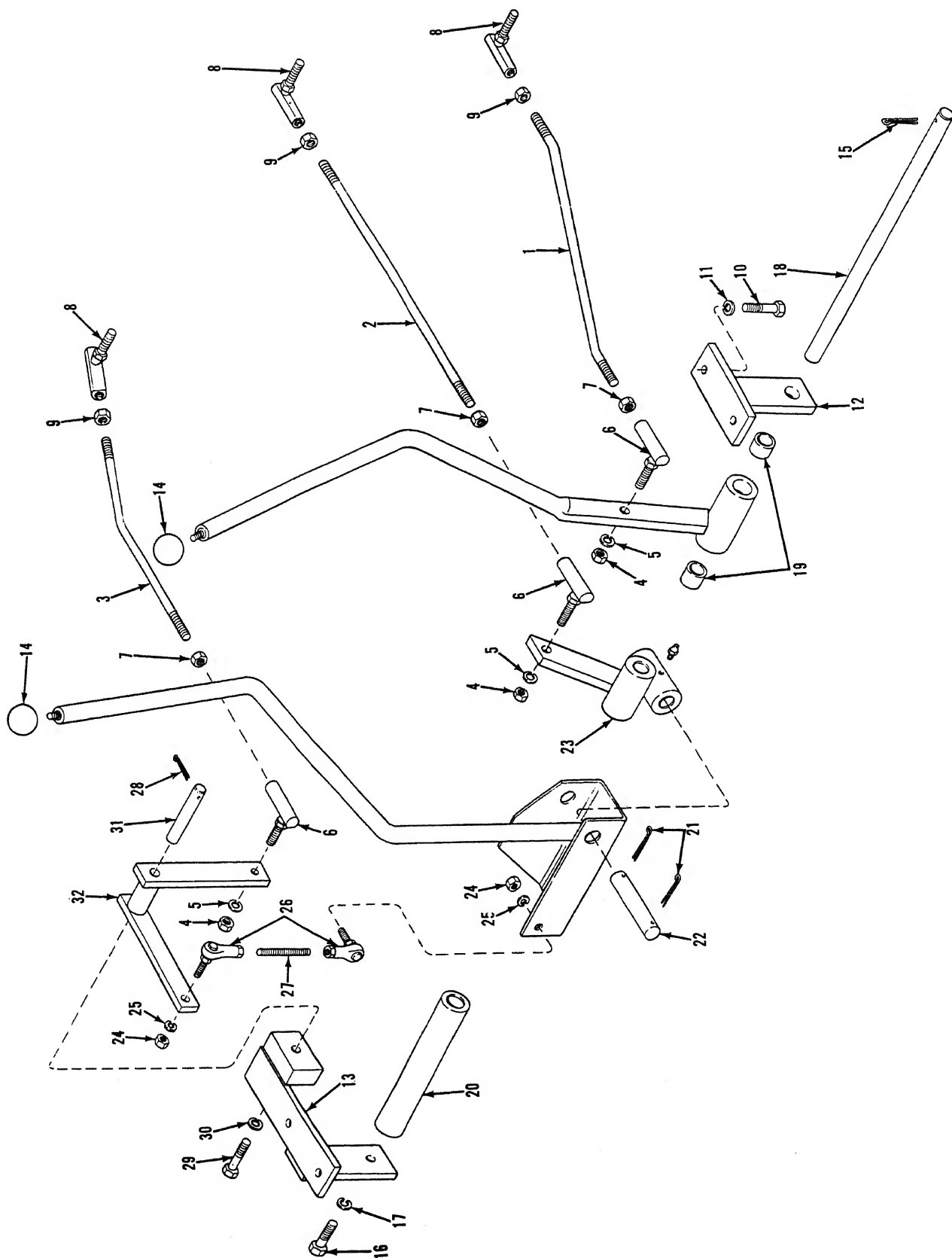


Figure 4-47. Control linkage, exploded view.

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KEY to fig. 4-47:

1. Link
2. Link
3. Link
4. Bolt
5. Lockwasher
6. Ball joint
7. Locknut
8. Ball joint
9. Locknut
10. Bolt
11. Lockwasher
12. Frame
13. Frame
14. Knob
15. Cotter key
16. Bolt

17. Lockwasher
18. Bar
19. Bushing
20. Tube
21. Cotter key
22. Pin
23. Mount
24. Bolt
25. Lockwasher
26. Joint
27. Stud
28. Cotter key
29. Bolt
30. Lockwasher
31. Pin
32. Linkage

c. *Installation*: Install linkage and levers by reversing the removal procedure.

d. *Adjustment*.

(1) Move the control levers through all operations and check the movement of spools in the loader control valve.

(2) Adjust the length of control rods to position the spools for proper operation.

(3) With the control levers in neutral and the engine running, ensure that there is no movement or chatter in hydraulic cylinders.

#### 4-60. Return to Dig Linkage

a. *General*.

(1) The return to dig linkage, mounted on the right tilt cylinder, automatically returns the bucket to a level or digging position after dump.

(2) A bucket sight level gage consists of pointers mounted on the end of the tilt cylinder and on the bellcrank. When the pointers are aligned, the bucket is in a level position.

b. *Removal*. (fig. 4-48).

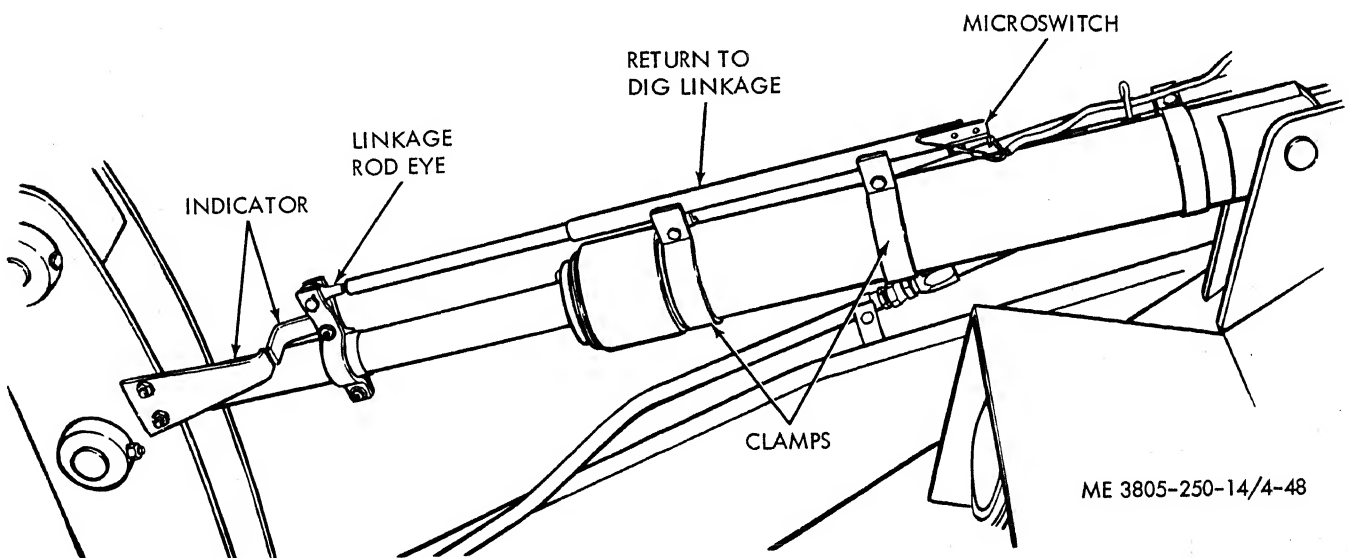
(1) Tag and disconnect wiring to the return to dig microswitch.

(2) Remove bolt, nut and lockwasher securing the return to dig cylinder to the tilt cylinder clamps.

(3) Remove cotter key and pin from the linkage rod eye. Remove return to dig linkage.

(4) Remove bolt, nut and lockwasher securing the cylinder half of the indicator.

(5) Remove bolts, washers, and nuts securing the bellcrank indicator.



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Figure 4-48. Return to dig linkage, removal and installation.

c. *Installation.* Install linkage by reversing the removal procedure.

d. *Adjustment.*

- (1) Rest the bucket flat on the floor.
- (2) Position the rod clamp fourteen inches from the bellcrank as shown in figure 4-49.

- (3) Position guide and microswitch on the tilt cylinder until the actuating rod contacts the switch roller but does not close the switch.

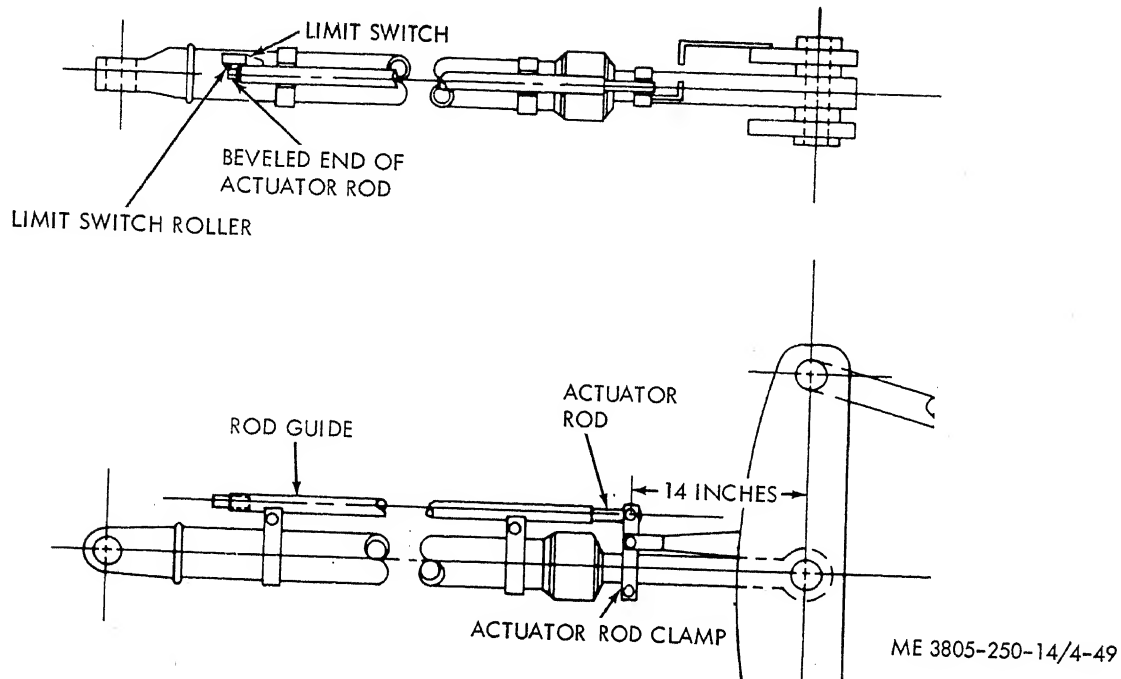


Figure 4-49. Return to dig linkage adjustment.

- (4) Align the guide on the rod and tighten mounting bolts.

- (5) To check adjustment, raise the bucket to full height and dump. Place the bucket lever in "RETRACT" and the boom lever in "FLOAT". When the bucket touches the ground, it should be level.

#### 4-61. Bucket Height Kickout Control

a. *General.* The bucket height kickout control lever is mounted on the left side of the cabin. The lever may be set in a 7, 8 or 9 foot kickout position. When the bucket reaches the set height, the left lift arm closes a limit switch and the boom control lever automatically returns to neutral.

b. *Removal.* Refer to figure 4-50.

- (1) Remove bolt and lockwasher securing cover to mechanism.
- (2) Tag and disconnect wiring to microswitch.
- (3) Remove three bolts from outside of the cabin and three nuts and lockwashers securing control to the side of the cab.
- (4) Remove setscrew and remove height control collar and pin assembly at the lift arm.
- (5) Pull the control into the cabin and remove from loader.

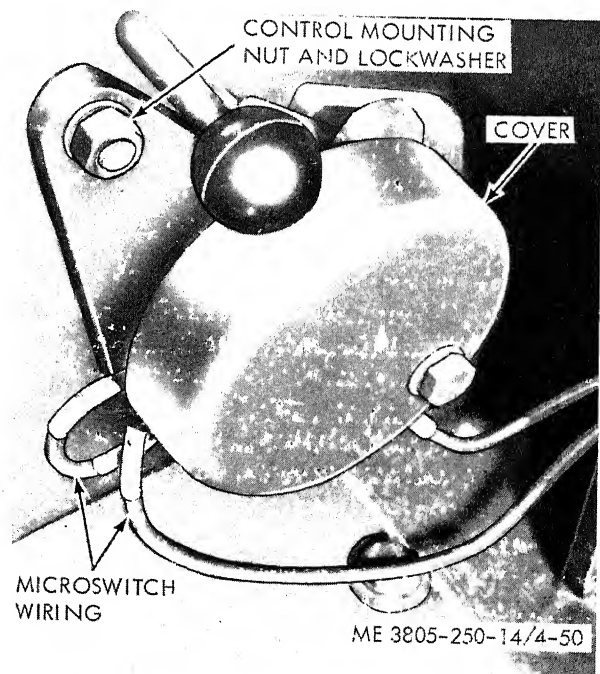


Figure 4-50. Bucket height kickout control, removal and installation.

c. *Installation.* Install control by reversing the removal procedure.

d. *Adjustment.*

(1) Raise the bucket to 7 feet above the ground in full dump position and block in position.

(2) Push the bucket height kickout control lever to the 7 foot position.

(3) Loosen the setscrew (fig. 4-51) and rotate the collar and pin assembly until contact is made with the pin on the lift arm. Tighten setscrew.

(4) Operate the bucket to check for proper adjustment.

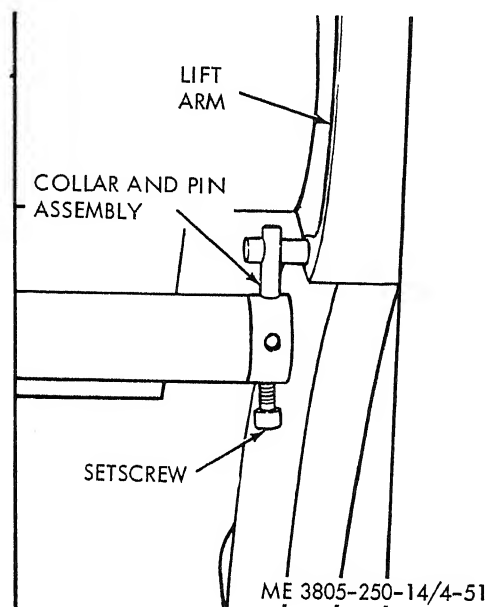


Figure 4-51. Bucket height kickout control adjustment.

## 4-62. Transmission Shift Linkage

a. *General.* The transmission shift linkage controls selection of range. The linkage consists primarily of the shift lever, mounted on the steering column, and a cable connected to the range selector on the transmission.

b. *Removal.* (fig. 4-52).

(1) Remove the stop (1) and pin (2).

(2) Remove nut (3), and setscrew (4), nut (5) and setscrew (6) from the air valve actuating arm (7).

(3) Remove bolts (8) securing the rod (9) to the side plate and to the lower support (10).

(4) Remove the key (11), and remove nut (12), lockwasher (13), and bolt (14) securing the lower end of the shift lever (15) to the lower lever (16). Remove the ball (17), and remove the shift lever through the cab floor.

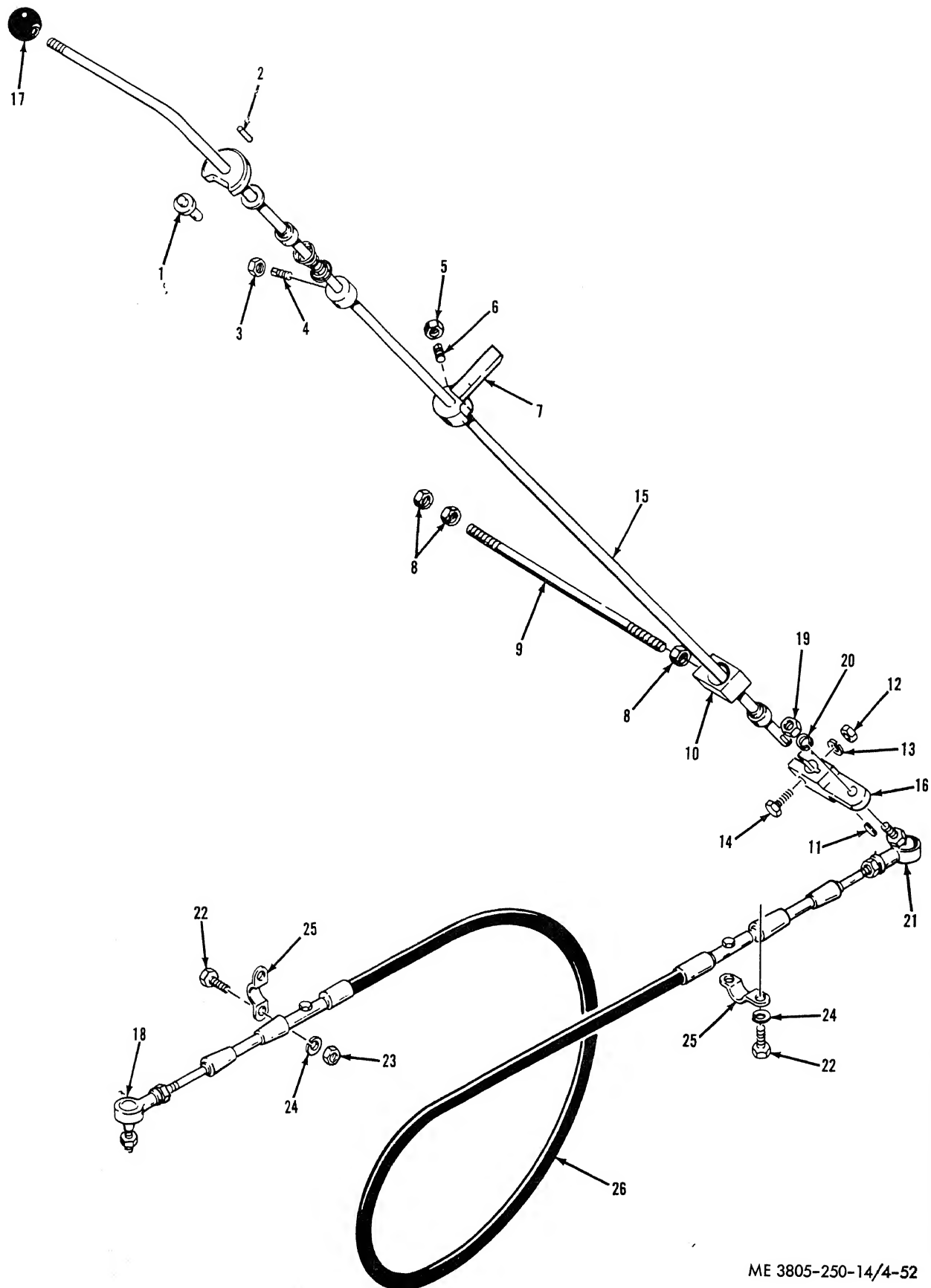
(5) Disconnect the ball joint (18) at the range selector on the transmission.

(6) Remove the nut (19) and lockwasher (20) securing ball joint (21) to the lower lever (16).

(7) Remove bolts (22, nuts (23), lockwashers (24) clamps (25) securing the cable (26) in position. Remove the cable from the loader.

KEY to fig. 4-52:

1. Stop
2. Pin
3. Nut
4. Setscrew
5. Nut
6. Setscrew
7. Arm
8. Bolts
9. Rod
10. Support
11. Key
12. Nut
13. Lockwasher
14. Bolt
15. Shift lever
16. Lower lever
17. Ball
18. Ball joint
19. Nut
20. Lockwasher
21. Ball joint
22. Bolts
23. Nuts
24. Lockwashers
25. Clamps
26. Cable



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Figure 4-52. Transmission shift linkage.

*c. Installation.* Install linkage by reversing the removal procedure.

*d. Adjustment.*

(1) Disconnect the shift cable at the transmission.

(2) Position the range selector on the transmission in reverse.

(3) Place the shift lever in reverse.

(4) Twist the ball joint (18, fig. 4-52) as necessary to align with the hole in the cross arm.

(5) Start the engine and check for proper shifting operation.

(6) Tighten the locknut on the end of the cable.

## Section XXIII. MAINTENANCE OF GAGES AND MEASURING DEVICES

### 4-63. Gages and Switches

*a. General.* The gages and switches mounted on the instrument board give the operator an indication of the condition of the loader operation. Refer to paragraph 2-8 for functions, normal readings and position of the gages and switches.

*b. Removal.*

(1) Remove gages as follows:

(a) Remove outer screws from the instrument panel and swing the panel section forward.

(b) Tag and disconnect wiring from the back of the gage.

(c) Remove any lines, hoses, or cables connected to the back of the gage. Cap openings.

(d) Remove two bolts, washers, and lockwashers securing each gage to the instrument panel.

(2) Remove switches as follows:

(a) Remove outer screws from the instrument panel and swing the panel section forward.

(b) Disconnect wiring from the back of the switch.

(c) Remove the switch through the back of the panel.

*c. Installation.* Install gages and switches by reversing the removal procedures.

## Section XXIV. MAINTENANCE OF PNEUMATIC EQUIPMENT

### 4-64. Air compressor Governor

*a. General.* The air compressor governor automatically maintains the air pressure in the air brake system within prescribed levels.

*b. Removal.* (fig. 4-53).

(1) Block the loader or apply the parking brake.

(2) Drain the air system.

(3) Clean the governor and connecting air lines.

(4) Disconnect air lines leading to the alcohol evaporator and air compressor. Cap or plug openings.

(5) Remove two bolts, lockwashers and nuts securing the governor to the air compressor, and remove the governor.

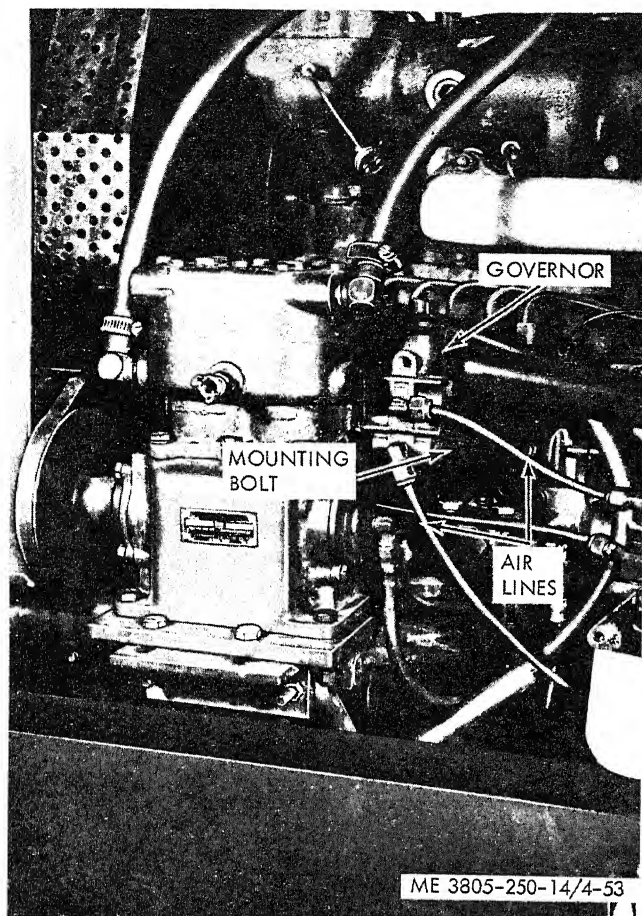


Figure 4-53. Air compressor governor, removal and in stallation.

c. *Installation.* Install governor by reversing the removal procedure.

d. *Adjustment.*

(1) With the air reservoir drains closed, start the engine and pressurize the air brake system. Check the air pressure gage on the instrument panel for the pressure at which the air compressor cuts out. Reading should be 125 psi.

(2) With the engine still running, apply the brakes several times to reduce the air pressure at which the compressor cuts in. Reading should be 105 psi.

(3) If necessary, screw off the governor top cover and turn the adjusting screw clockwise to lower the pressure setting or counterclockwise to raise the setting. Tighten the screw locknut after setting and screw on the cover.

(4) Perform steps (1) through (3) until proper gage indications are obtained.

#### 4-65. Air Compressor Belt

a. *General* The air compressor belt, routed

around the fan pulley and air compressor pulley, drives the air compressor crankshaft.

b. *Replacement.*

(1) Loosen the two air compressor mounting bolts (fig. 4-54).

(2) Loosen the nuts on the hook bolts and slide the compressor towards the engine.

(3) Remove the belt. Slip the new belt over the fan and onto the fan and compressor pulleys.

(4) Adjust the belt (subpara. c).

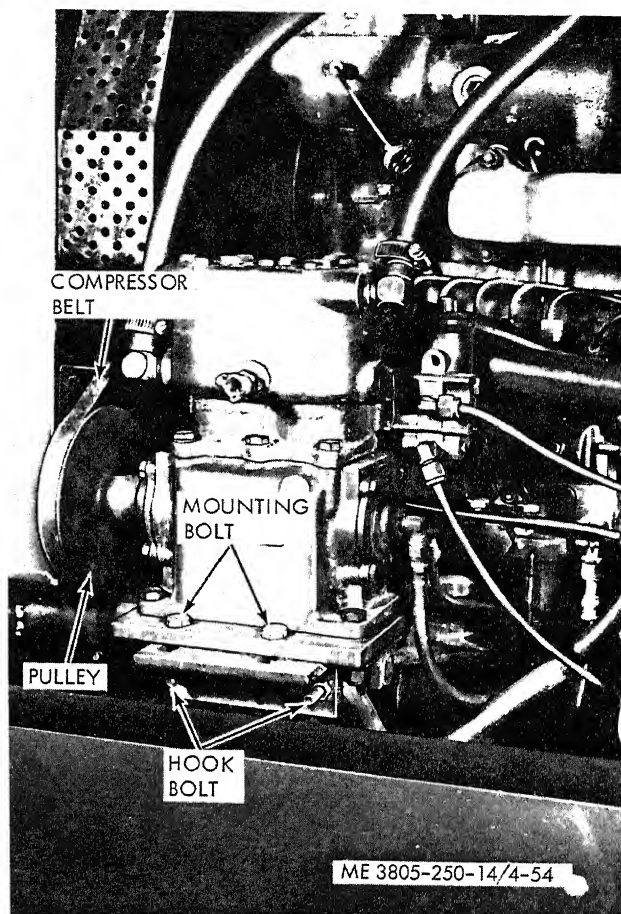


Figure 4-54. Air compressor belt.

c. *Adjustment.* Adjust the belt for a deflection of  $\frac{1}{2}$  inch at a point midway between the pulleys with an applied tension of 60 pounds.

(1) Loosen the two air compressor mounting bolts (fig. 4-55).

(2) Turn the nuts on the hook bolts clockwise to tighten belt tension or counterclockwise to loosen belt tension.

(3) Ensure that the air compressor pulley is aligned with the fan pulley and tighten the air compressor mounting bolts.

## Section XXV. MAINTENANCE OF EARTH MOVING EQUIPMENT

### 4-66. Lift Arms

*a. General.* The lift arms are connected to the front frame with pins and extensions to the lower part of the bucket. The lift arms move to change the vertical position of the bucket.

*b. Service.* Lubricate the lift cylinder pivot, bellcrank, bucket attachment, and upper pivot daily. Refer to the Lubrication Order to the correct lubricant.

### 4-67. Tilt Linkage

*a. General.* The tilt linkage provides attachment and pivot points for the cylinders and bucket linkage. The linkage moves to tilt the bucket.

*b. Service.* Lubricate the tilt cylinder pivot points, bellcranks and other moving parts daily. Refer to the Lubrication Order for the correct lubricant.



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## CHAPTER 5

### DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

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#### Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

##### **5-1. Tools and Equipment**

Tools and equipment issued with, or authorized for the MW24 Scoop Loader are listed in the Basic Issue Items List, appendix C.

##### **5-2. Special Tools and Equipment**

Special tools and test equipment required to perform direct support and general support maintenance on the MW24 Scoop Loader are listed

in table 5-1 and TM5-3805-250-34P. References and illustrations indicating the use of these tools and equipment are listed in the table.

##### **5-3. Maintenance Repair Parts**

Repair parts and equipment are listed and illustrated in the repair parts manuals, TM 5-5805-20P and TM 5-3805-250-34P.

Table 5-1. Special Tools and Equipment (including fabricated items)

Item	Reference number	Reference		Use	Figure (fabricated items)
		Figure	Paragraph		
Clamping bar	A28312	6-39	6-20	Check cylinder sleeve protrusion	5-1
Ball	24918	6-39	6-20	Check cylinder sleeve protrusion	
Plate	CF83-4	6-39	6-20	Check cylinder sleeve protrusion	
Locating dowel	A40953	6-40	6-20	Cylinder head installation	
Tongs	CF83-1	6-41	6-20	Cylinder head installation	
Puller set	A41103	6-55	6-24	Camshaft bushing removal and installation	
Seal installing tool	A60533	6-56	6-24	Cranksaft front seal installation	
Pump assembly	65-0934	6-15	6-3	Testing fuel injectors	
Fuel injector tool kit	66-0010	6-13	6-3	Cleaning and servicing fuel injectors	
Torque wrench adapter	A42393	6-37	6-20	Removing and installing cylinder heads	
Sleeve puller kit	5120-417-2952			Removing cylinder sleeves	
	970	6-48	6-2	Installing piston ring assemblies	
Ring compressor	849-T	6-50	6-21	Removing piston rings	
Ring expander	5120-393-0549				
	616	6-47	6-21		
Voltmeter and ammeter	4910-911-6391			Testing electrical circuitry	
	VAT24				
Growler	6625-857-9163	8-6	8-3	Testing starter armature	
	40-215				
Alternator service set	5180-691-2914			Servicing alternator	
	A200S	8-1	8-2	Miscellaneous bearing pulling and installation	
Puller set	5180-925-4591			Remove and install lift cylinder gland	
	Y1735			Remove and install tilt cylinder gland	
Spanner wrench	D44116	8-25	8-13	Remove and install clam and steering cylinder glands	
Spanner wrench	D44115	8-25	8-13	Check hydraulic pump output	
Spanner wrench	D44112	7-48	7-31		
Flowmeter	HS60-3	8-8	8-7	Remove and install brake shoe return springs	
	M20270	8-9	7-31	Installing wheel hub bearing cups	
Brake spring pliers	5120-690-8044	7-21	7-14	Installing planetary drive internal gear hub bearing cone	
Bearing driver	131A		7-13	Installing differential case half bearing cones	
Bearing driver			7-13	Installing differential outer pinion bearing cone	
Bearing driver			7-13	Installing differential pinion bearing cage cup	
Bearing driver			7-13	Installing differential pinion bearing cage cup	
Bearing driver			7-13	Installing differential pinion inner bearing	
Bearing driver			7-13	Installing wheel hub seal	
Seal driver			7-14	Checking wheel hub bearing preload	
Torque wrench adapter bar		7-27	7-14		5-10

Item	Reference number	Reference		Use	Figure (fabricated items)
		Figure	Paragraph		
Spindle nut socket Puller set Wiper removal tool Planetary pin staking tool Compression gage	70-003	7-26 7-3	7-14 7-2 8-12 7-3	Removing and inattalling wheel spindle nuts Loosening torque converter pump bearing Removing clam spool wiper Checking engine compression	5-11 5-12 5-13 5-14

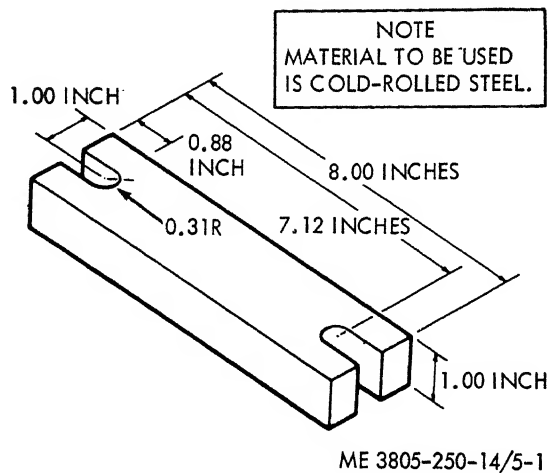


Figure 5-1. Clamping bar.

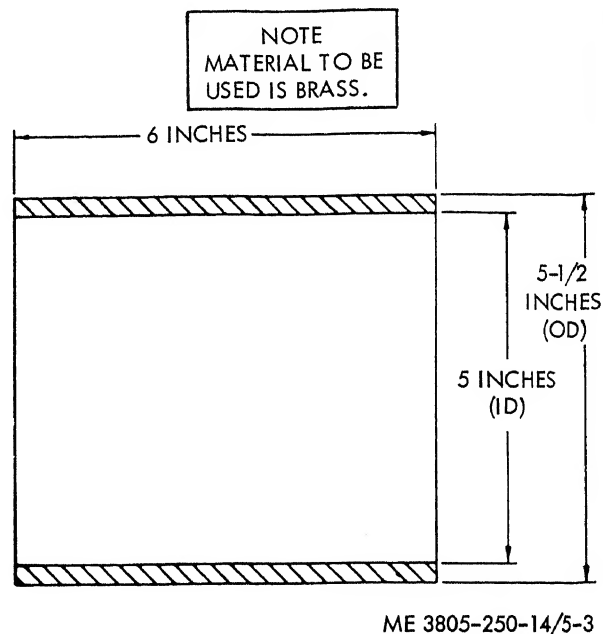


Figure 5-3. Planetary drive internal gear hub bearing cone.

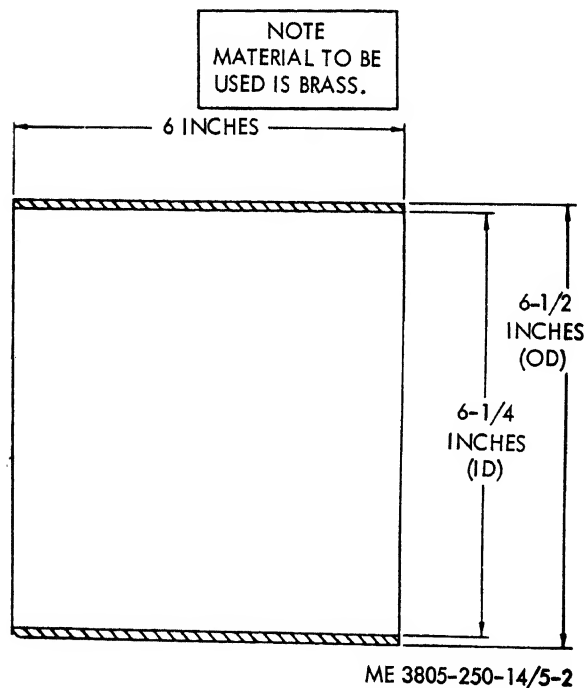


Figure 5-2. Wheel hub bearing cup driver.

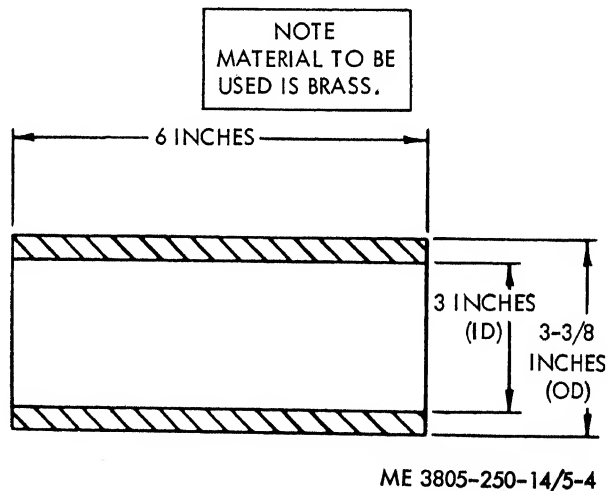
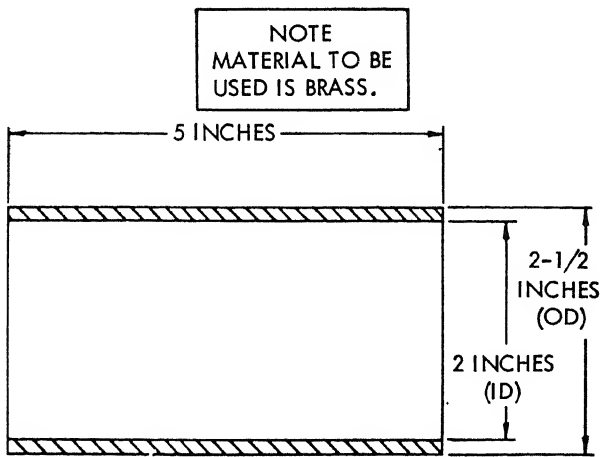
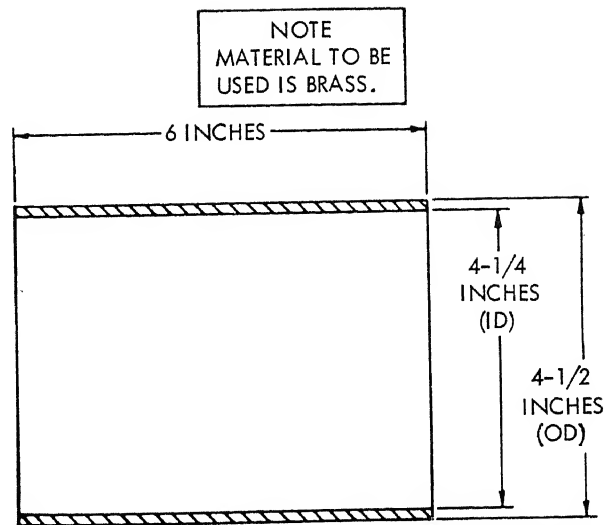


Figure 5-4. Differential case half bearing cone drum.



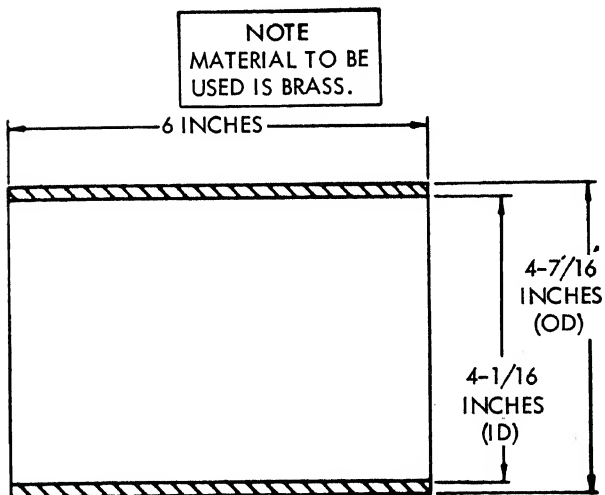
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**Figure 5-5. Differential pinion outer bearing cone driver.**



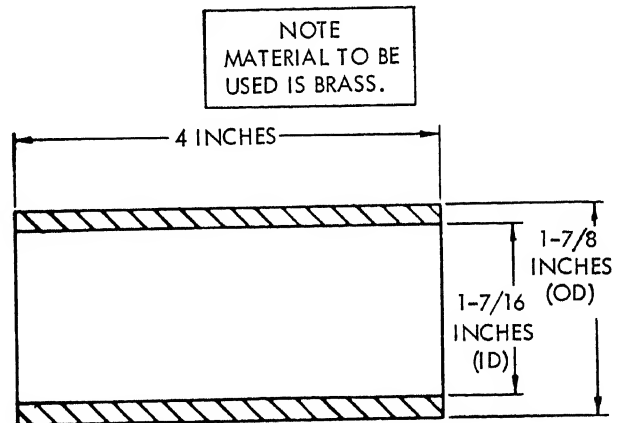
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**Figure 5-7. Differential pinion bearing cage cup driver.**



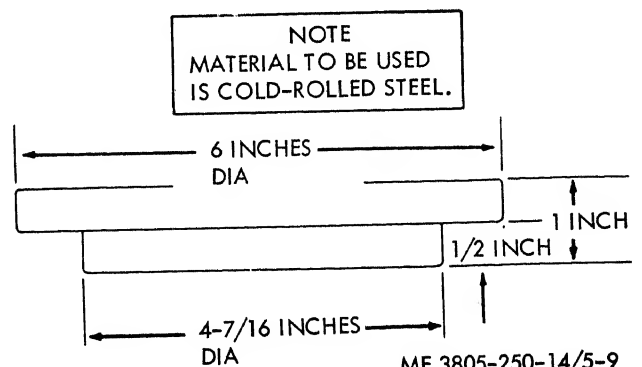
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**Figure 5-6. Differential pinion bearing cage cup driver.**



ME 3805-250-14/5-8

**Figure 5-8. Differential pinion inner bearing drive.**



ME 3805-250-14/5-9

**Figure 5-9. Seal driver.**

- NOTE
1. MATERIAL TO BE USED IS COLD-ROLLED STEEL.
  2. ALL DIMENSIONS ARE IN INCHES.

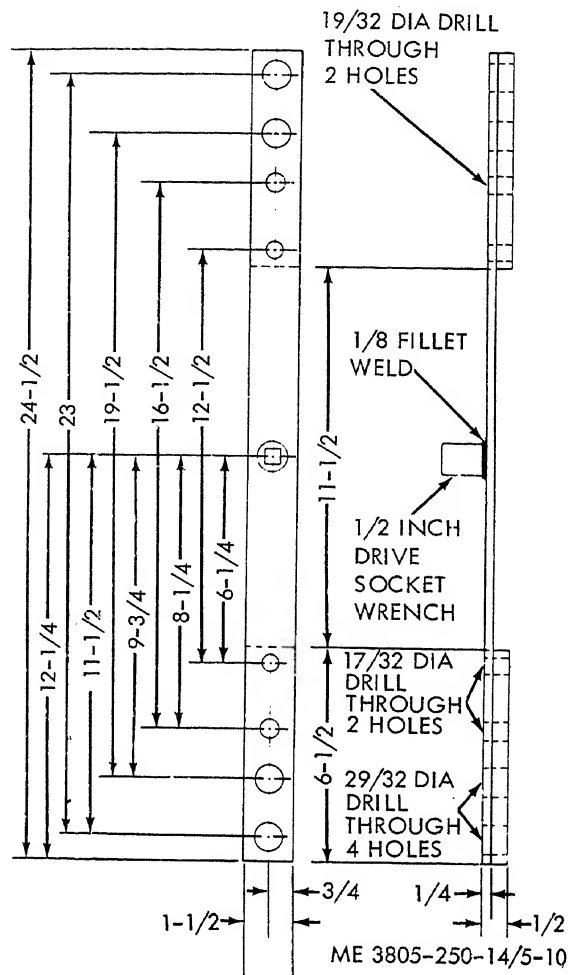


Figure 5-10. Torque wrench adapter bar.

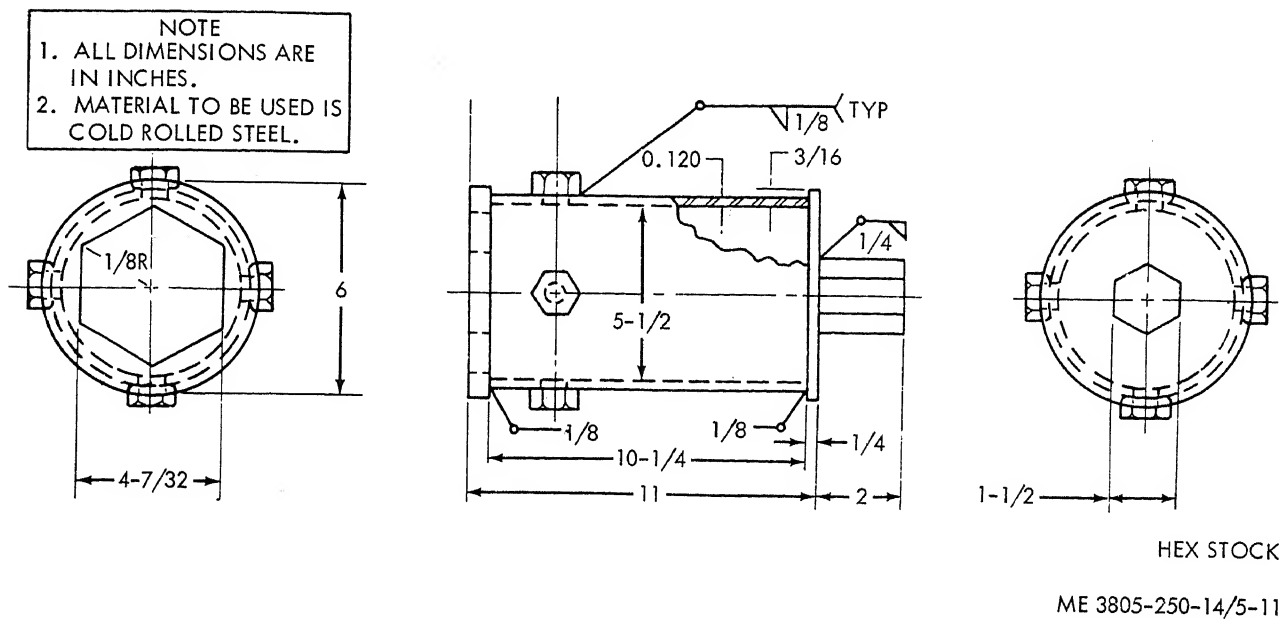


Figure 5-11. Spindle nut socket.

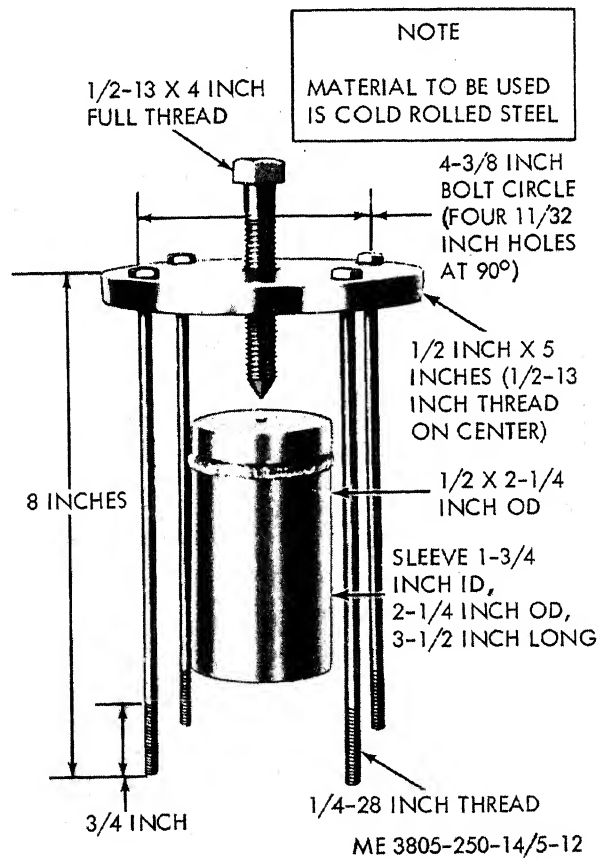


Figure 5-12. Torque converter pump bearing puller set.



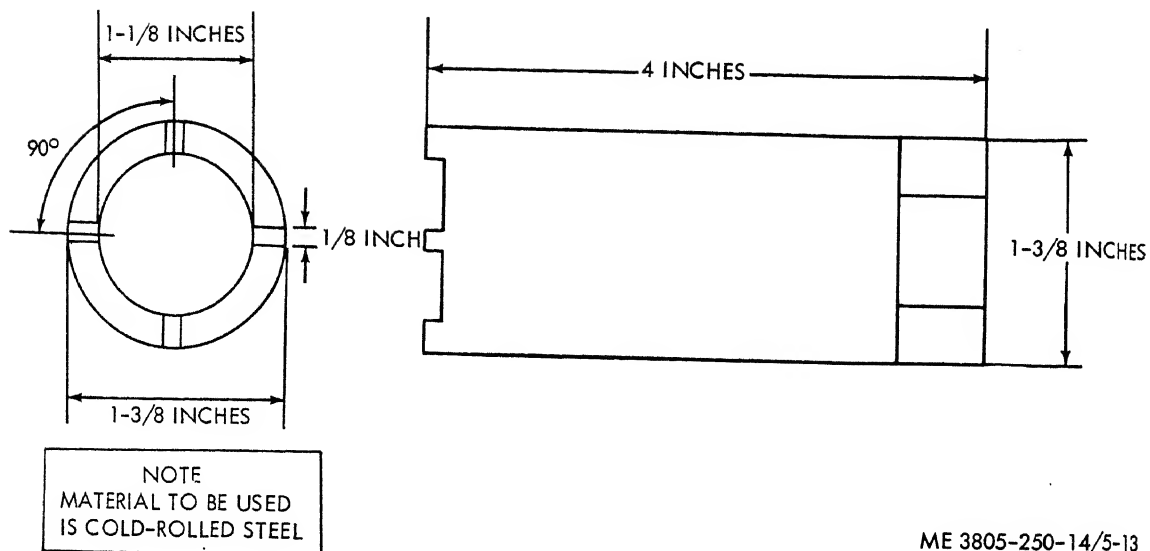


Figure 5-13. Wider removal tool

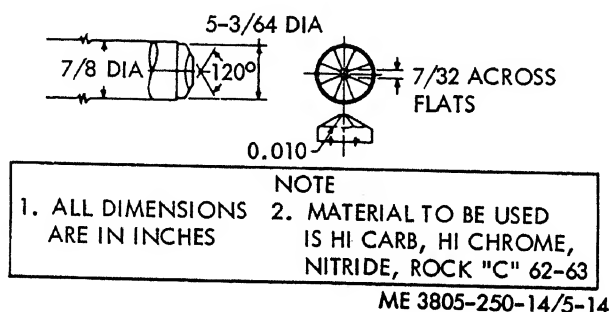


Figure 5-14. Planetary pin staking tool

## Section II. TROUBLESHOOTING

### 5-4. General

Table 5-2 provides information for diagnosing and correcting improper operation or failure of the

loader components. Each symptom is followed by a list of probable causes and possible remedies.

Table 5-2. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Engine fails to start.	a. Fuel injection nozzles not receiving fuel.	a. Check fuel system. Replace defective lines or nozzles (para 6-3).
2. Engine hard to start	b. Defective fuel injection pump.	b. Repair or replace pump (para 6-2).
	a. Defective fuel injection nozzle.	a. Replace (para 6-3).
	b. Fuel injection pump defective or not properly timed.	b. Check timing. Repair or replace pump if necessary (para 6-2).
3. Engine stops frequently.	a. Idling speed too low.	a. Adjust idle speed (para 6-2).
	b. Restrictions in fuel lines.	b. Check fuel lines and correct.

Table 5-2. Troubleshooting — Continued

Malfunction	Probable Cause	Corrective Action
4. Engine stops suddenly.	a. Restrictions in fuel line or damaged line. b. Defective fuel injection pump.	a. Check fuel lines and correct. b. Repair or replace pump (para 6-2).
5. Engine overheats.	a. Radiator core clogged, leaking or damaged. b. Defective water pump. c. Engine oil cooler defective. d. Faulty engine lubrication system. e. Improperly timed or defective fuel injection pump.	a. Repair or replace radiator (para 6-16). b. Repair or replace pump (para 6-15). c. Repair cooler or replace if necessary (para 6-10). d. Inspect lubrication components for defects. Repair faulty component e. Repair or replace pump (para 6-2).
6. Engine power low.	a. Insufficient fuel to nozzles. b. Fuel injection pump improperly timed. c. Cylinder cutting out.	a. Inspect fuel pump, lines, and filters and correct. b. Time pump (para 6-2). c. Inspect cylinders and nozzles. Correct defect (para 6-20).
7. Engine runs unevenly and vibrates	a. Erratic or insufficient fuel supply b. Defective fuel nozzles. c. Defective fuel injection pump. d. Valves burned or damaged.	a. Check fuel system and correct. b. Replace or repair nozzles (para 6-3). c. Repair or replace pump (para 6-2). d. Repair valves or replace if necessary (para 6-20). Repair or replace pump (para 6-2).
8. Engine emits black smoke in exhaust.	Defective fuel injection pump.	a. Repair starter (para 8-3) or replace (para 4-32).
9. Starter does not crank engine	a. Defective starter.	a. Repair (para 8-2) or replace (para 4-30). b. Replace (para 4-31). Repair or replace (para 6-7).
10. Electrical system not providing power.	a. Defective alternator, b. Defective alternator regulator. Defective turbocharger.	a. Tighten clamps or replace as necessary. b. Replace gasket or replace manifold (para 6-8). Repair defective components (ch 7).
11. Air intake system not properly.	a. Loose or defective clamps.	
12. Exhaust system not operating properly.	b. Defective exhaust manifold.	
13. Loader will not move.	Defective transmission driveshafts, differentials, or planetaries.	
14. Loader does not steer properly.	a. Defective steering cylinder. b. Defective hydraulic pump. c. Defective flow divider valve. d. Defective steering gear assembly.	a. Repair or replace cylinder (para 7-31). b. Repair or replace pump (para 8-8). c. Repair or replace valve (para 7-30). d. Repair or replace gear (para 7-28).
15. Lift arms do not raise or lower.	a. Defective loader control valve. b. Defective hydraulic pump. c. Defective lift cylinder.	a. Repair or replace valve (para 8-12). b. Repair or replace pump (para 8-8). c. Repair or replace cylinder (para 8-13).
16. Bucket does not operate properly	a. Defective loader control valve. b. Defective hydraulic pump. c. Defective tilt cylinder. d. Defective clam cylinder.	a. Repair or replace valve (para 8-12). b. Repair or replace pump (para 8-8). c. Repair or replace cylinder (para 8-13). d. Repair or replace cylinder (para 8-13).
17. Wheel brakes do operate properly.	e. Defective bucket. a. Defective brake actuator b. Defective brake. c. Leaky or damaged air reservoir. d. Defective compressor governor.	e. Repair bucket (para 9-6). a. Repair actuator (para 7-22). b. Repair brake (para 7-21). c. Repair or replace as necessary (para 8-16). d. Replace governor (para. 4-64) or repair (para 8-15).
18. Parking brake does not hold.	a. Linkage bent or damaged. b. Defective parking brake.	a. Replace damaged components (para 7-20). b. Repair (para 7-20).

## Section III. GENERAL MAINTENANCE

### 5-5. General

This section contains general maintenance information that would otherwise have to be repeated throughout this manual.

### 5-6. Maintenance Requirements

*a. Hardware and Threaded Parts.* Inspect hardware for damaged threads, rounded corners, and damaged slots. Threaded holes and parts should accept their mating parts without requiring excessive torque. Threads may be chased with a tap or die. Replace any threaded parts which cannot be repaired.

*b. Gaskets.* Replace all gaskets which were disturbed during repair operations or which show evidence of leakage. When installing gaskets, use grease or gasket cement to retain gasket in position during reassembly procedures.

*c. Oil Seals and Packings.* Thoroughly lubricate the sealing lip of spring loaded seals with grease or other suitable lubricant when installing. Apply non-hardening sealer to the outer circumference of encased seals or to the mating bores to prevent possible leakage. Immerse preformed packings in the fluid or lubricant with which they will be in contact.

*d. Ball and Roller Bearings.* After removing antifriction bearings, cover them immediately to keep out dirt and abrasives. Flush thoroughly with solvent, tap them against a wooden block to remove packed lubricant, and air-dry. Coat cleansed bearings with oil, and wrap in clean paper until

installation. Replace any bearings that are scored, pitted, discolored from overheating, or otherwise damaged. When installing bearings against shoulders, be sure the chamfered side is toward the shoulder. Lubricate bearing and its mating surface when pressing. Press bearings only on the race adjacent to the mating part. Use drivers which contact as much of the race as possible.

*e. Repair of Damaged Machined and Polished Surfaces.* Remove rough spots, scores, burrs, galling, gouges, and other surface damage from machined and polished surfaces. Use a suitable honing stone, crocus or emery cloth, file, or any other method that will permit the part to function efficiently. The finish of the part must approximate that of the original finish. Critical dimensions must not be altered beyond acceptable limits. Shafts, rods, and other worn parts may be built up by metallizing, chrome plating, or welding and regrinding to original size.

*f. Welding Repair.* Welding must be performed by a qualified welder. Welds must provide complete fusion and penetration and comply with governing specifications. All welds should be inspected using a radiographic or magnetic particle process. All new welds should be ground flat and smooth whenever possible.

*g. Part Replacement.* Parts which are worn or defective should be replaced with new parts. Factors such as age, mileage, operating hours, usage, and parts availability should be considered when part replacement is necessary.

## Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

### 5-7. Engine and Transmission

#### *a. Removal.*

(1) Drain the engine coolant. Remove the rille (para 4-54), batteries (para 4-34), radiator para 6-16) and shroud (para 4-26).

(2) Remove the exhaust pipe (para 4-22) and air cleaner (para 4-21). Disconnect lines to the fuel pressure gage hourmeter, and air cleaner indicator. Remove the hood (para 4-51) and front hood support.

(3) Drain hydraulic system and remove the hydraulic pump (para 8-8). Remove hydraulic lines which would hinder transmission removal.

(4) Remove the plug from the oil pan and drain engine oil.

(5) Disconnect the following:

(a) Rear harness from front harness.

(b) Wiring to alternator and alternator regulator.

(c) Wiring to stop, tail, and blackout lights.

(d) Wiring to oil pressure switch, oil pressure sender and water temperature sender.

(e) Return fuel line at fuel tank.

(f) Fuel line from tank to fuel filter.

(g) Air compressor lines.

(h) Accelerator linkage at fuel injection pump.

(i) Drive shafts at the transmission.

(6) Remove the two front head bolts, attach an appropriate sling to the bolts, and reinstall head bolts.

(7) Install two 3/4-10 NC eyebolts in the tapped holes in top of the transmission housing, and attach the sling to the eyebolts.

(8) Remove engine and transmission mounting bolts. Remove cotter key, nut, washer, and spring from the rear engine mount.

(9) Lift the engine and transmission from the chassis.

(10) Remove twelve capscrews and lock-washers securing the torque converter to the flywheel housing. Slide the transmission away from the engine.

**b. Installation.**

(1) Install engine and transmission by reversing the removal procedure. Ensure that the engine is parallel to the ground while being hoisted.

(2) Install or connect items which were removed.

(3) Install new oil and fuel filters and service the engine oil, hydraulic oil, and cooling systems.

(4) Start the engine and check all systems for malfunctions and leaks.

**5-8. Front and Rear Axles**

**a. Removal.**

(1) Drain planetary housings and differential.

(2) Disconnect the drive shaft at the differential.

(3) Disconnect the brake lines to the wheel cylinder.

(4) On the front axle, disconnect the parking brake linkage.

(5) Block the opposite end of the loader from the axle which is to be removed. Jack or support the chassis.

(6) Remove the tires and wheels (para 7-26).

(7) Attach a hoist to the ends of the axle or support.

(8) Remove eight bolts securing the axle to the frame. Lower to the ground and snake from under the loader.

**b. Installation.**

(1) Install axle by reversing the removal procedure. Install tires and wheels (para 7-26), and connect linkages.

(2) Fill the planetary housing and differential with lubricant.

(3) Adjust and bleed the brakes (para 4-43).

## CHAPTER 6

### REPAIR OF ENGINE

#### Section I. FUEL SYSTEM

##### 6-1. General

a. The fuel system consists of a fuel tank, electric fuel pump, transfer fuel pump, fuel filters, fuel injection pump, fuel injection nozzles, and fuel lines.

b. An electric fuel pump delivers fuel from the tank through the primary fuel filter to the transfer pump mounted on the fuel injection pump. The

transfer pump delivers the fuel to the secondary fuel filter and back to the fuel injection pump, where the fuel is delivered under high pressure to the fuel injection nozzles and the engine cylinders. Excess fuel is returned from the fuel injectors to the fuel tank through an overflow line. Refer to figure 6-1 for a schematic diagram of the fuel system.

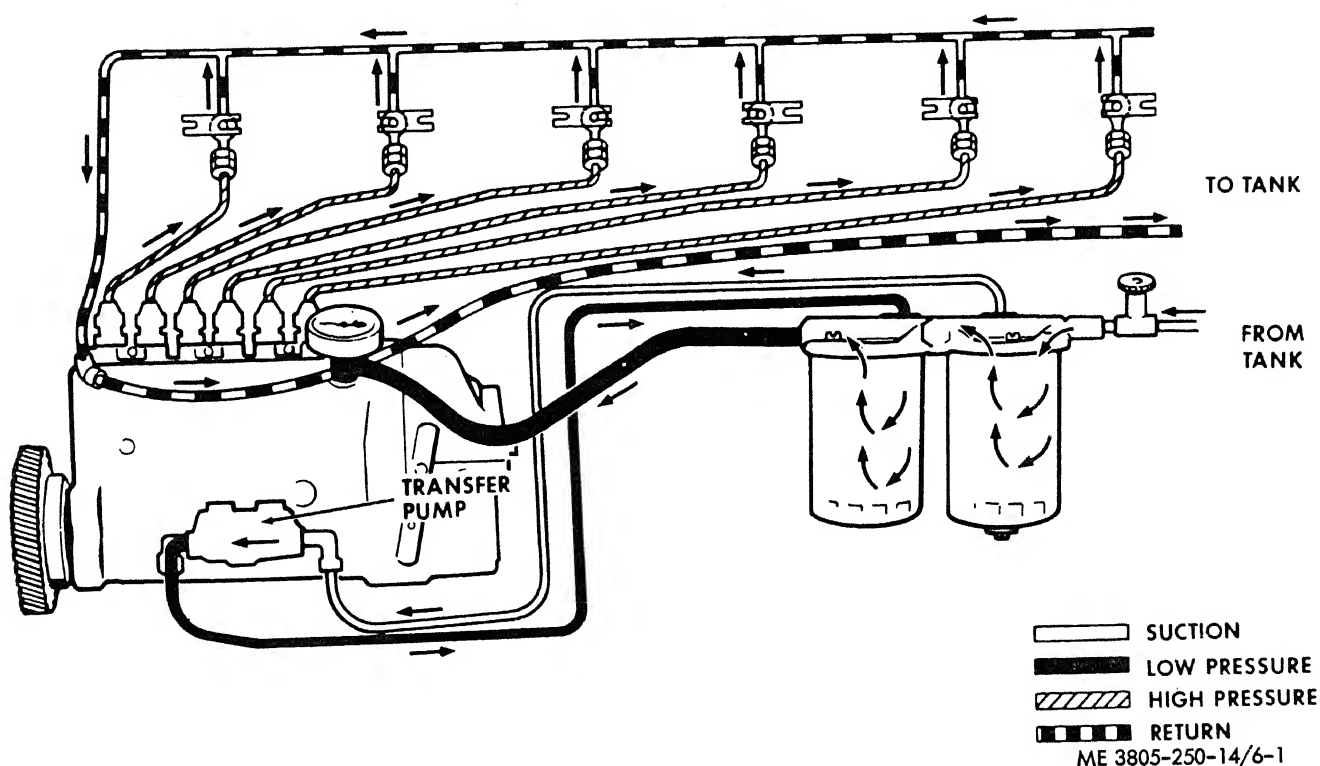


Figure 6-1. Fuel system schematic diagram.

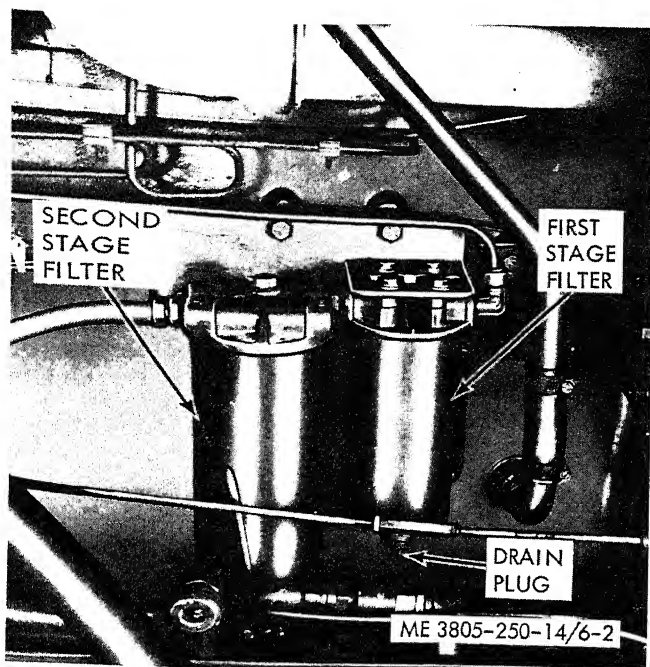
##### 6-2. Fuel Injection Pump

###### a. Removal.

- (1) Remove the right engine side panel.
- (2) Steam-clean the engine thoroughly in the

area of the fuel injection pump and connecting lines.

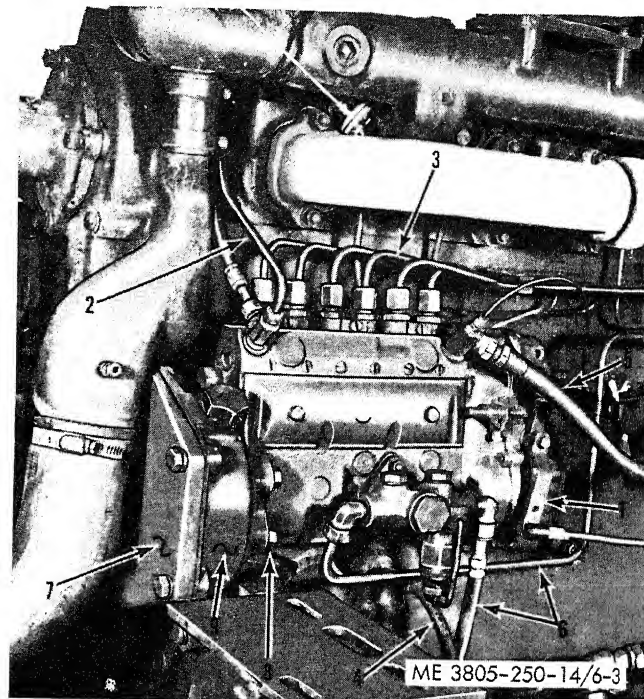
- (3) Close the shutoff valve at the electric fuel pump. Remove the drain plug from the first stage filter and drain the filters (fig. 6-2).



*Figure 6-2. Draining fuel filters.*

(4) Remove the air cleaner (para 4-21), fender (para 4-51), vertical support, and air compressor (para 8-15) to gain access to the fuel injection pump.

(5) Disconnect the throttle rod from the governor control arm (1, fig. 6-3) and fuel shutoff arm.



*Figure 6-3. Fuel injection pump, removal and installation.*

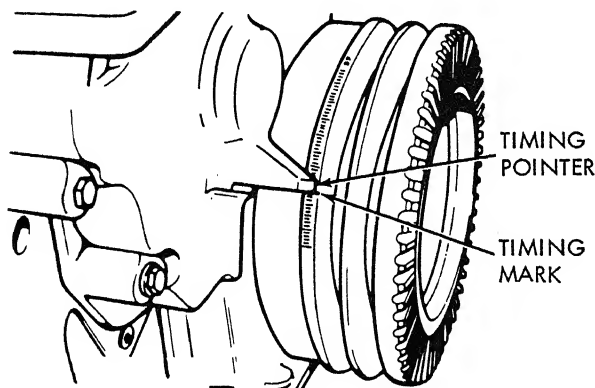
(6) Disconnect the fuel leak-off line (2), six high pressure lines (3), pump lube line (4), and primary fuel hose (5) from the fuel pump ports.

*Note.* Cap or plug all lines and fittings as soon as lines are disconnected to prevent contamination by dirt.

(7) Disconnect lines (6) to transfer fuel pump.

(8) Align the engine crankshaft pulley timing mark with the timing pointer on the timing gear cover (fig. 6-4) as follows:

(a) Crank the engine clockwise until the timing mark is aligned with the timing pointer.



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Figure 6-4. Timing mark alignment.

(b) Remove the valve covers from the No. 1 and No. 2 cylinders and check the No. 1 cylinder push rods for tightness. If both are tight, crank the engine 360 degrees and again check the push rods. Both should be loose when the No. 1 cylinder is on the TDC (top dead center) of compression stroke.

(c) Crank the engine counterclockwise to the 35 degree mark, then crank clockwise to 30 degrees BTDC (before top dead center) fuel pump timing.

(9) Remove the fuel pump drive gear cover (7, fig. 6-3).

(10) Remove the capscrews securing the fuel pump drive gear.

(11) Remove the four pump mounting nuts (8), and carefully remove the pump from the timing gear cover (9).

*Note.* Use an extension wrench to remove the inside mounting nuts.

**b. Disassembly of Fuel Pump.** (Refer to figure 6-5.)

(1) Remove the two bolts (1) and washers (2) securing inspection cover (3) to the pump. Discard gasket (4).

(2) Remove three nuts (5) and washers (6) securing the transfer fuel pump (7) to the housing. Disassemble as described in subparagraph c. Discard gasket (8).

(3) Remove and disassemble the governor as described in subparagraph d.

(4) Clamp the pump in a vise. Bring the roller tappets (30) to top dead center. Lift the tappets above TDC and hold to permit easy removal of the camshaft (25).

(5) Remove closing plugs (9).

(6) Remove bolt (10) and washer (11), and remove coupling half (12) from the camshaft.

(7) Remove screw (13) and washer (14) securing the timing pointer (15) to the bearing end plate. Remove outer end plate half (16) and discard preformed packing (17). Remove screws (18) and lockwashers (19) securing inner end plate half (20) to pump housing. Remove seal (21).

(8) Remove bolts (22) and washers (23) securing support (24).

(9) Remove camshaft (25) from the housing, and remove taper roller (26), bearing (27), shims (28) and key (29) from the camshaft.

(10) Remove roller tappet (30) with forceps. Remove roller pin (31), bushing (32) and roller (33).

(11) Remove spacer (34), lower spring seat (35), plunger spring (36), upper spring seat (37), sleeve (38), slider (39), gear segment (40), plunger and barrel (41) and delivery valve (42) through the bottom of the pump.

*Note.* Label components for installation in the same bores they are removed from.

(12) Remove cap (43), screw (44) and washer (45), and carefully extract control rod (46).

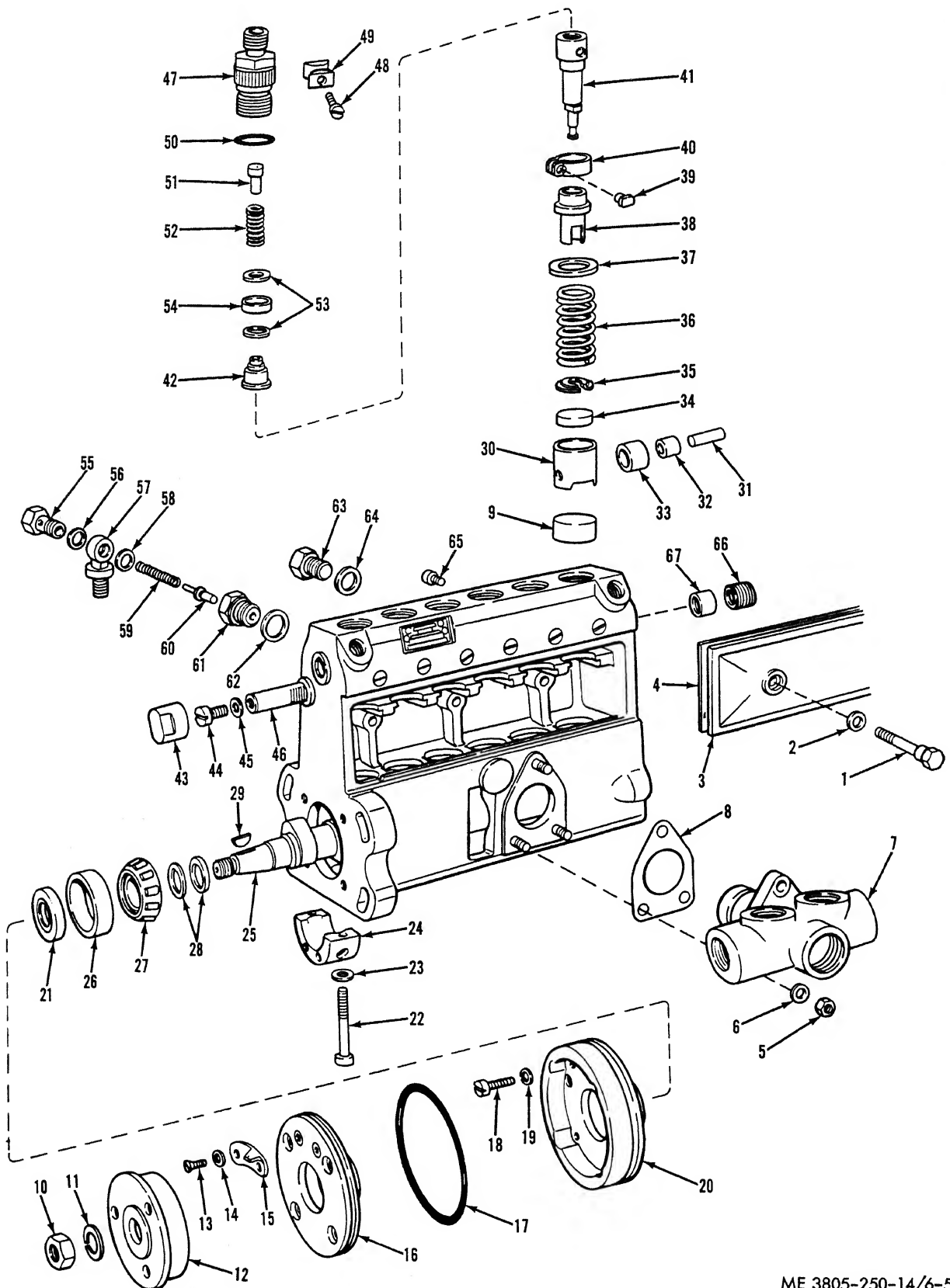
(13) Screw out the delivery valve holders (47) with a spanner wrench. Remove screw (48) and clamping jaws (49). Discard preformed packing (50).

(14) Lift out pin (51), spring (52), washers (53) and spacer (54).

(15) Remove oil feed valve assembly, and remove screw (55), washer (56), fitting (57), washer (58), spring (59), valve stem (60), connector (61) and preformed packing (62).

(16) Remove screw (63) and preformed packing (64), locating screw (65), bushing (66) and guide ring (67).





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Figure 6-5. Fuel pump, exploded view.

KEY to fig. 6-5:

- |                       |                           |
|-----------------------|---------------------------|
| 1. Bolt               | 34. Spacer                |
| 2. Washer             | 35. Spring seat           |
| 3. Cover              | 36. Spring                |
| 4. Gasket             | 37. Spring seat           |
| 5. Nut                | 38. Sleeve                |
| 6. Washer             | 39. Slider                |
| 7. Transfer fuel pump | 40. Gear segment          |
| 8. Gasket             | 41. Plunger and barrel    |
| 9. Plug               | 42. Delivery valve        |
| 10. Bolt              | 43. Cap                   |
| 11. Washer            | 44. Screw                 |
| 12. Coupling half     | 45. Washer                |
| 13. Screw             | 46. Control rod           |
| 14. Washer            | 47. Delivery valve holder |
| 15. Pointer           | 48. Screw                 |
| 16. End plate         | 49. Clamping jaw          |
| 17. Preformed packing | 50. Preformed packing     |
| 18. Screw             | 51. Pin                   |
| 19. Lockwasher        | 52. Spring                |
| 20. End plate         | 53. Washer                |
| 21. Seal              | 54. Spacer                |
| 22. Bolt              | 55. Screw                 |
| 23. Washer            | 56. Washer                |
| 24. Support           | 57. Fitting               |
| 25. Camshaft          | 58. Washer                |
| 26. Taper roller      | 59. Spring                |
| 27. Bearing           | 60. Valve stem            |
| 28. Shim              | 61. Connector             |
| 29. Key               | 62. Preformed packing     |
| 30. Roller tappet     | 63. Screw                 |
| 31. Roller pin        | 64. Preformed packing     |
| 32. Bushing           | 65. Locating screw        |
| 33. Roller            | 66. Bushing               |
|                       | 67. Guide ring            |

*c. Disassembly of Transfer Fuel Pump.* Refer to figure 6-6.

(1) Remove screw plug (1), spring (2), plunger (3), and spindle (4) from the pump housing. Remove and discard gasket (5) and preformed packing (6).

(2) Remove slider (7) and roller pin (8). Slide out roller (9).

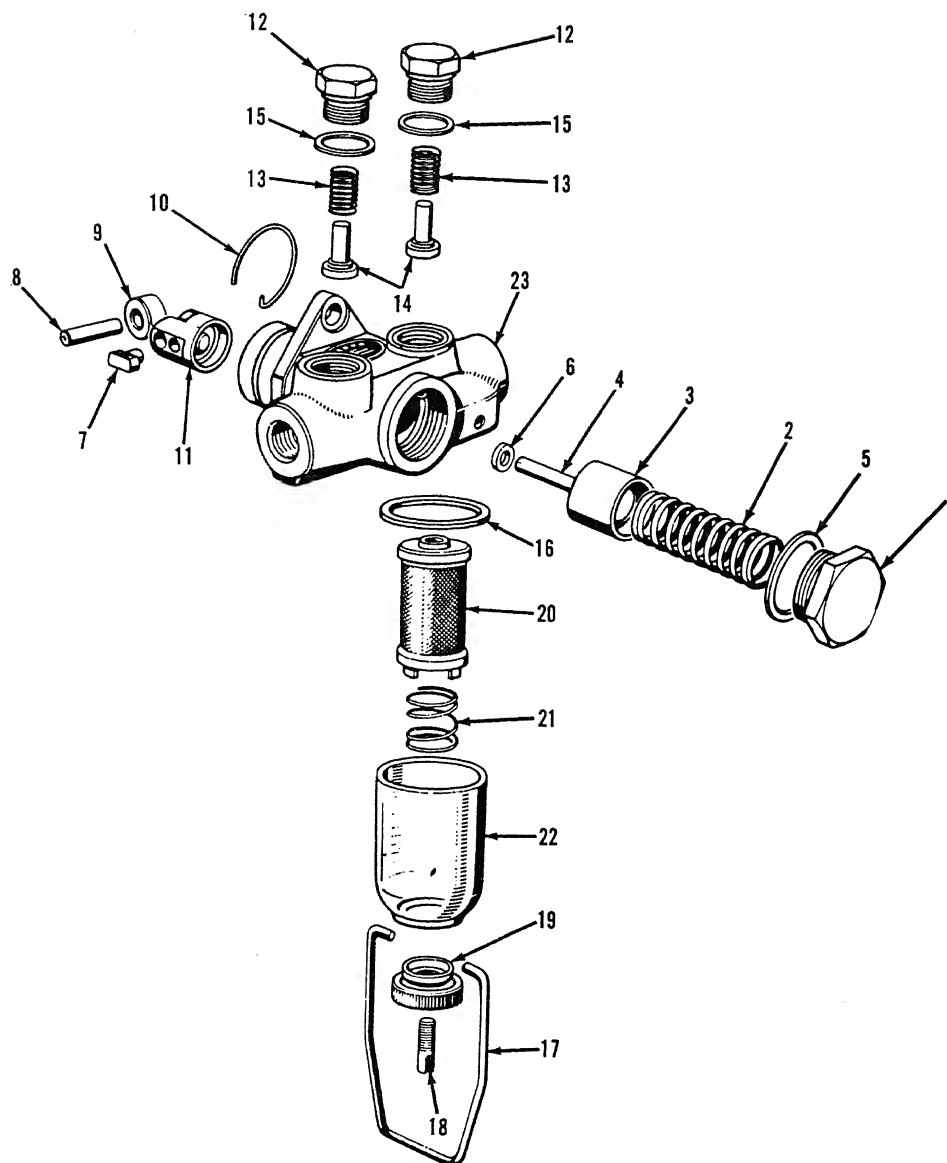
(3) Remove snap ring (10) and roller tappet (11).

(4) Remove the two screw plugs (12) from the top of the housing. Take out springs (13) and valves (14). Discard gaskets (15).

(5) Loosen the clamping nut, and remove the filter assembly from the pump housing. Discard the gasket (16).

(6) Pull out the sides of the clip (17) and remove from the pump housing. Remove the stud bolt (18) and clamping nut (19) from the clip.

(7) Remove the filter (20) and spring (21) from the filter housing (22).



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1. Screw plug
2. Spring
3. Plunger
4. Spindle
5. Gasket
6. Preformed packing
7. Slider
8. Roller pin
9. Roller
10. Snap ring
11. Roller tappet
12. Screw plug

13. Spring
14. Spindle
15. Gasket
16. Gasket
17. Clip
18. Stud bolt
19. Clamping nut
20. Filter
21. Spring
22. Filter housing
23. Body

Figure 6-6. Transfer fuel pump, exploded view.

*d. Disassembly of the Governor.* Refer to figure 6-7.

(1) Secure the fuel injection pump in a vise.

(2) Unscrew cap nut (1) and remove locknut (2), washers (3), spring capsule (4) and spring (5).

(3) Remove sealing wire (6), and remove four screws (7). Lift off end cover (8) and gasket (9). Collect oil as it runs out of the governor.

(4) Remove bolts (10 and 11) securing the governor cover (12) to housing (23). Loosen the cover by striking lightly with a rubber hammer. Carefully separate from housing.

(5) Release link (13) and lever (14) from the fuel pump control rod. Unhook the starting spring (15) from the eye in the governor cover using thin-nosed pliers.

(6) Remove the cover from the housing. Discard gasket (16).

(7) Release round nut (17) on the flyweight assembly (18) by inserting a pin wrench into the nut and rotating the coupling at the opposite end of the camshaft.

(8) Remove lockwasher (19) and withdraw the flyweight assembly. Remove key (20) from the camshaft taper.

(9) Lift the fuel injection pump roller tappets and tappet holders (para 6-2). Remove screws (21) and washers (22) securing governor housing (23) to fuel pump housing. Lightly tap with a rubber hammer to separate the housings. Unscrew stop

screw (24) and locknut (25). Remove gasket (26).

(10) Remove plugs (27) and shaft (28) and maneuver link (13), governing lever (14), guide lever (29), starting spring (15), and bearing (30) downward from the swivel lever (31) and remove. Separate parts and remove washers (32).

(11) Maneuver the tension lever (33) under the swivel lever and remove. Remove capsule (34) and locknut (35). Unhook spring (36) from the eye of the tension lever and the eye of the swivel lever.

(12) Remove bolt (37) and lockwasher (38), cutout lever (39), spring capsule (40), spring (41), and washer (42).

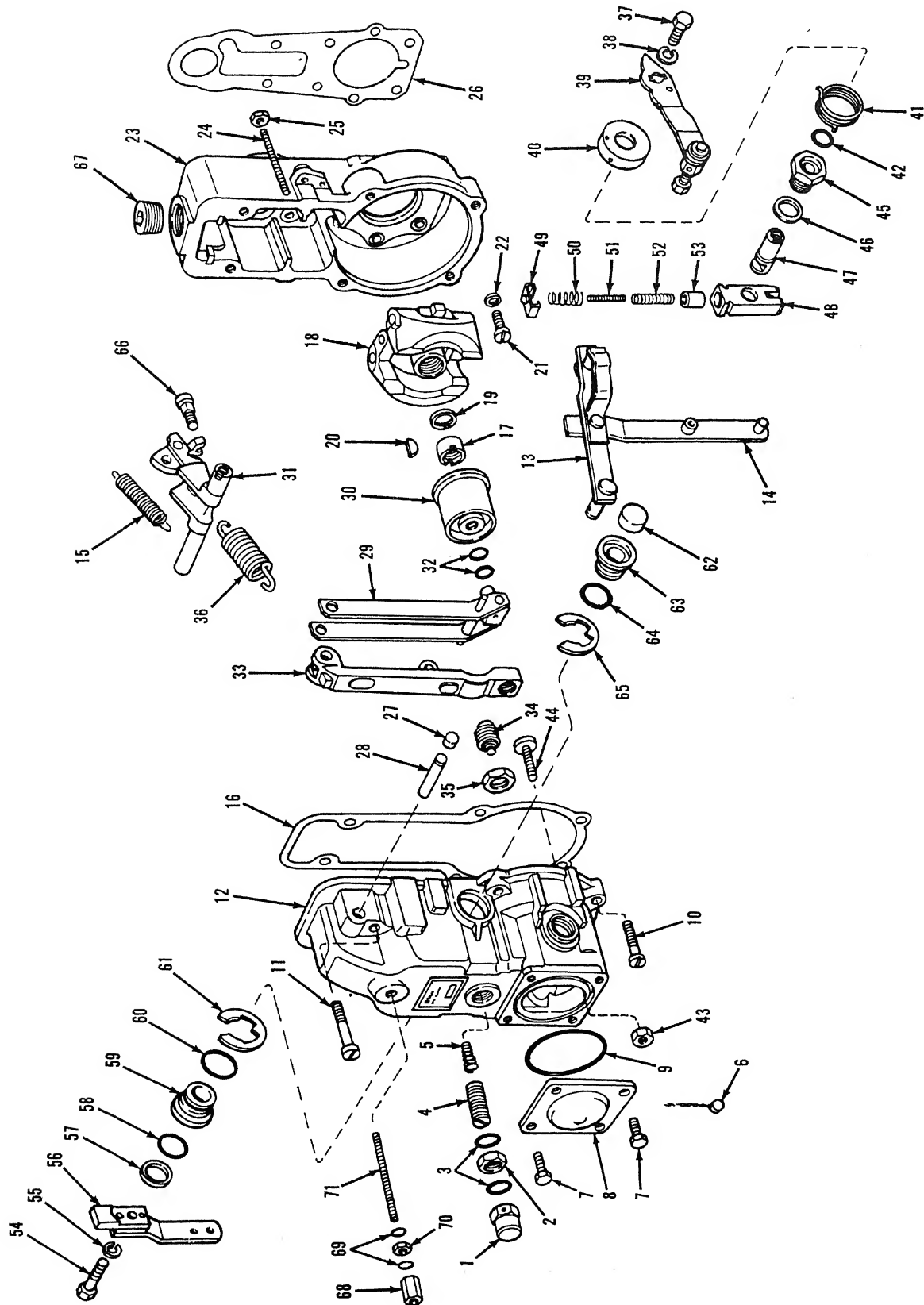
(13) Unscrew locknut (43) and stop screw (44). Remove bearing bushing (45) and washer (46), spindle (47), and lever (48). Remove retaining clip (49), springs (50, 51 and 52), and spring capsule (53).

(14) Unscrew capscrew (54) and remove lockwasher (55). Remove swivel lever (56), spacer (57), preformed packing (58), bushing (59), preformed packing (60) and retaining ring (61). On opposite side of cover, remove cap (62), bushing (63), preformed packing (64) and retaining ring (65).

(15) Remove bolt (66) securing swivel lever (29) to cover and remove the lever.

(16) Remove cap (67) from the housing.

(17) Remove cap (68), washers (69), locknut (70) and stop screw (71) from cover.



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Figure 6-7. Governor, exploded view.

KEY to fig. 6-7:

1. Cap nut
2. Locknut
3. Washer
4. Spring capsule
5. Spring
6. Sealing wire
7. Screw
8. End cover
9. Gasket
10. Bolt
11. Bolt
12. Cover
13. Link
14. Governing lever
15. Spring
16. Gasket
17. Nut
18. Flyweight
19. Lockwasher
20. Key
21. Screw
22. Washer
23. Housing
24. Stop screw
25. Locknut
26. Gasket
27. Plug
28. Shaft
29. Guide lever
30. Bearing
31. Swivel lever
32. Washer
33. Tension lever
34. Capsule
35. Locknut

36. Spring
37. Bolt
38. Lockwasher
39. Cutout lever
40. Spring capsule
41. Spring
42. Washer
43. Locknut
44. Stop screw
45. Bearing bushing
46. Washer
47. Spindle
48. Swivel lever
49. Clip
50. Spring
51. Spring
52. Spring
53. Spring capsule
54. Capscrew
55. Lockwasher
56. Lever
57. Spacer
58. Preformed packing
59. Bushing
60. O-ring
61. Retaining ring
62. Cap
63. Bushing
64. Preformed packing
65. Retaining ring
66. Bolt
67. Cap
68. Cap
69. Washer
70. Locknut
71. Stop screw

*e. Cleaning, Inspection and Repair.*

(1) *Fuel pump.*

(a) Clean all components with solvent. Immerse moving parts in test oil before reassembly.

(b) Replace worn and damaged parts.

(c) Inspect sliding surfaces of pump plungers for grooves and scratches. Check that the helix of the plungers is not rounded.

(d) Inspect the retainer collar of the delivery valve for grooves and scratches, and replace if surfaces cannot be smoothed with emery cloth.

(e) Replace pump plungers and barrels as a unit.

(f) Replace delivery valve as a unit.

(g) Inspect roller tappets, camshaft cams and camshaft bearings for wear, and replace as necessary.

(h) Inspect the control rod for worn notches.

(i) Replace all gaskets, packing rings, and preformed packings. Fit all preformed packings with grease.

(2) *Governor.*

(a) Inspect housing and cover for breaks, cracks, and rough mating surfaces. Repair by welding.

(b) Inspect control levers for cracks, breaks, and worn bores. Inspect pins for wear and damage. Replace worn parts.

(c) Inspect springs for cracks and other damage. Replace weak or defective springs.

(d) Inspect rollers and bushings for wear. Replace bushings if worn or loose. Replace rollers if worn or out-of-round.

(3) *Transfer Fuel Pump.*

(a) Inspect valves for wear, dents, nicks, or corrosion. Smooth surfaces with a polishing cloth or replace as necessary.

(b) Inspect spindle for alignment, and replace if bent.

(c) Inspect springs for cracks and weak condition. Replace as necessary.

(d) Replace filter element.

*f. Reassembly of Transfer Fuel Pump.* Reassemble pump by reversing the disassembly procedure. Observe the following:

(1) Tighten screw plug (1, fig. 6-6) to a torque of 44 to 50 pound-feet.

(2) Tighten screw plugs (12) to a torque of 18 to 25 pound-feet.

*g. Reassembly of Governor.* Refer to figure 6-7.

(1) Lubricate all moving parts before installing.

(2) Cover face of housing (23) with sealing compound, and install housing and new gasket (26) to the fuel pump. Secure with screws (21) and washers (22). Install stop screws (24) and temporarily install locknuts (25).

(3) Insert key (20) into camshaft keyway and position flyweight assembly (18) over camshaft.

*Note.* Ensure that camshaft and flyweight taper are absolutely clean.

(4) Position lockwasher (19) and round nut (17) on camshaft. Tighten the nut to 50 to 55 pound-inches.

(5) Coat spindle (47) with grease and install into lever (48) and bearing bush (45) with washer (46). Install washer (42) and thoroughly greased spring (41). Position spring capsule (40) in the housing. Insert the end of the spring into the hole in cut-out lever (39). Secure lever with bolt (37) and lockwasher (38).

(6) Install spring capsule (53) and springs (50, 51 and 52) into lever (48) and secure with clip (49).

(7) Temporarily screw stop screw (44) into governor cover and engage with locknut (43).

(8) Temporarily install adjusting screw (66). Insert the knobs of the swivel lever (31) into the two governor cover bearing bores with the groove in the lever on top.

(9) Insert bushings (59 and 63) with sealing rings (60 and 64) from the outside into the governor cover. Slide the bushes over the swivel lever bearing spigots. Firmly press in the bearing bushings until retaining ring grooves are visible and press in retaining rings (61 and 65).

(10) Install cap (62). On the opposite side of the cover install preformed packing (58), spacer (57) and lever (56). Secure with capscrew (54) and lockwasher (55).

(11) Place washers (32) in position on bearing (30) and press bearing into position on lever (29). Insert guide lever (29) and governing lever (14) with link (13) into the governor cover by pushing in from below the swivel lever. Insert the governing lever pivot into the groove of quadrant lever (48). Install shaft (28) into the cover far enough to temporarily hold one leg of the governing lever.

(12) Hook spring (15) into the eye of the governing lever.

(13) Screw capsule (34) into tension lever (33) and secure with locknut (35). Engage the governor spring (36) in the tension lever (33) and the swivel lever (31). Maneuver the tension lever into the

governor cover so that the stop nose aligns with stop screw (44).

(14) Slide shaft (28) through the holes in the guide and tension levers and tighten plugs (27) securely.

(15) Coat the face of cover (12) with sealing compound and position a new gasket (16) on the governor housing.

(16) Hold cover next to housing and hook starting spring (15) into the eye in housing. Connect link (13) to the injection pump control rod.

(17) Secure cover to housing with bolts (10 and 11). Push the control rod to the stop position and check that the rack automatically returns to the full load position. Tighten bolts to a torque of 3.5 to 5.0 pound-feet.

(18) Install stop screw (71) and washers (69), locknut (70) and cap (68).

(19) Install spring (5), spring capsule (4), washers (3), locknut (2) and capnut (1).

(20) Install gasket (9) and cover (8). Secure with screws (7) and sealing wire (6).

(21) Install cap plug (67).

*h. Reassembly of Fuel Pump.* (Refer to figure 6-5.)

(1) Lubricate all movable parts with test oil before assembling.

(2) Insert plunger and barrel assemblies (41) and delivery valves (42) into the fuel pump bores. Install washers (53), spacer (54), spring (52), pin (51), preformed packing (50) and delivery valve holder (47). Install clamping jaw (49) and tighten screw (49) securely.

(3) Fit gear segment (40), slider (39), sleeve (38), spring seat (37), spring (36) and spring seat (35) in position. Install control rod (46). Install washer (45), screw (44) and cap (43).

(4) Insert spacer (34) and roller tappets (30) into position. Install roller (33), bushing (32) and pin (31) so that the pin fits into the groove in the pump housing.

(5) Force the tappet upwards and install plug (9).

(6) Hold the tappets above TDC and install camshaft (25). Release tappets.

(7) Install key (29) into groove in camshaft and install shims (28), bearing (27), and taper roller (26). Insert seal (21) into end plate half (20). Install end plate half on camshaft and secure with screws (18) and lockwashers (19).

(8) Assemble and install governor (sub-paragraph *g*).

(9) Install end plate half (16) with new preformed packing (17). Install pointer (15) with screws (13) and washer (14). Tighten screws to a



torque of 60 to 72 pound-inches. Install coupling-half (12), lockwasher (11) and bolt (10).

(10) Install support (24) with washers (23) and bolts (22).

(11) Install preformed packing (62), connector (61), valve stem (60), spring (59), washer (58), fitting (57), washer (56) and screw (55).

(12) Install preformed packing (64) and screw (63). Install locating screw (65). Install guide ring (67) and bushing (66).

(13) Assemble transfer fuel pump (sub-paragraph f) and install new gasket (8). Secure with washers (6) and nuts (5).

(14) Install cover (3) with new gasket (4) and secure with bolts (1) and washers (2).

#### *i. Installation.*

*Note.* If the engine was cranked after the fuel pump was removed, perform step (6) of the removal procedure.

(1) Align the timing mark on the drive coupling with the timing pointer (fig. 6-4).

(2) Install the injection pump to the timing gear cover (9, fig. 6-3) and tighten mounting nuts (8) finger-tight.

(3) Install the drive gear with three capscrews. Tighten to a torque of 35 to 42 pound-feet.

*Note.* Install the machined flange side of the drive gear toward the injection pump flange.

(4) Remove the plug from the timing hole in the timing gear cover. If the injection pump is properly timed to the engine, the timing marks will be aligned. If necessary, move the pump toward or away from the engine until the marks are aligned. Tighten the pump mounting nuts (8) to a torque 35 to 42 pound-feet.

(5) Using a dial indicator, check the backlash between the pump gear and idler gear. If backlash exceeds 0.012 inch, replace gears.

(6) Install the pump drive gear cover (7) with new gasket. Tighten  $\frac{3}{8}$ -inch bolts to a torque of 35 to 42 pound-feet and the 5 / 16-inch bolt to 17 to 20 pound-feet.

(7) Connect the leak-off line (2), lube line (4) and primary fuel hose (5) so that the nuts seat against the shoulders of the fittings. Ensure that the rubber sleeves seat properly and do not bind.

(8) Connect the high-pressure fuel lines (3) finger-tight plus one-eighth turn.

(9) Connect the throttle rod and the fuel shut-off rod.

(10) Time the pump to the engine.

(11) Install the air compressor (para 8-15), finder (para 4-5), vertical support, and air cleaner (para 4-21).

(12) Install the drain plug on the first stage filter. Open the fuel shutoff valve at the electric fuel pump. Turn the ignition switch to the "ON" position to activate the electric fuel pump, and bleed the fuel system.

(13) Start the engine and check for leaks.

(14) Install the engine side panel.

#### *j. Test and Adjustment.*

##### *(1) Engine speed check.*

*Note.* Engine speed check is a critical measurement and must be performed with a tachometer known to be accurate.

(a) Allow the engine to run until the temperature gage indicates normal operating temperature.

(b) Hold the tachometer conical tip in position on the engine shaft until the pointer stops moving. The reading is the no load governed speed.

(c) Repeat step (b) at least twice.

(d) Average the tachometer readings. At proper adjustment, the no load governed engine speed should be between 2315 and 2365 rpm.

(2) No load governed speed adjustment.

(a) Increase the no load governed speed as follows:

1. Check that the governor control lever (fig. 6-8) rests against the no load governed speed adjustment screw when the throttle is in the no load governed speed position. If necessary, adjust the throttle linkage until the lever rests against the screw. Check engine speed.

2. If the control lever rests against the adjusting screw and engine speed is still low, loosen the locknut (fig. 6-8) and turn the no load governed engine speed adjusting screw counterclockwise one-half turn at a time. Check engine speed with each half turn of adjustment. When proper engine speed is attained, tighten locknut.

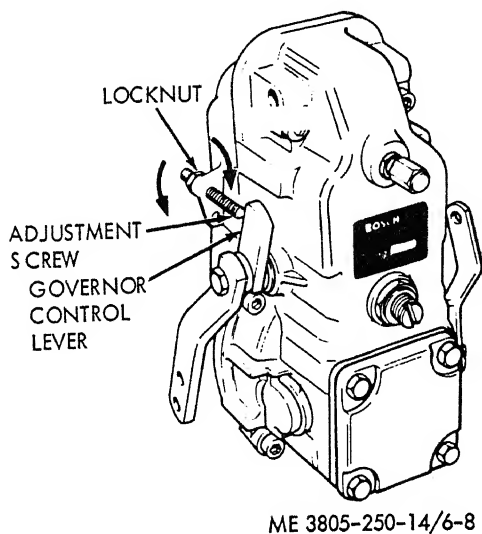


Figure 6-8. No load governed speed adjustment.

(b) Decrease no load governed speed as follows:

1. Loosen locknut (fig. 6-8).
2. Turn the no load governed engine speed adjusting screw clockwise one-half turn. Recheck engine speed with each half turn of adjustment.
3. Tighten locknut.

(c) If the no load governed speed adjusting screw has been turned, reseal. Record the date the seal was broken and the reason why adjustment was necessary.

(3) Supplementary Idle Screw Adjustment. When the engine idle speed suddenly drops to a very low rpm then speeds up, adjust the supplementary idle adjusting screw as follows:

(a) Remove the seal cap nut (fig. 6-9) and loosen the locknut.

(b) Turn the supplementary idle adjusting screw clockwise approximately  $\frac{1}{8}$  turn. If engine speed is still erratic, move the screw a little at a time until the engine idles smoothly. Tighten the locknut, reinstall the cap nut, and reseal.

*Note:* Do not turn the adjusting screw too far clockwise; low idle speed will increase.

(c) Check engine speed.

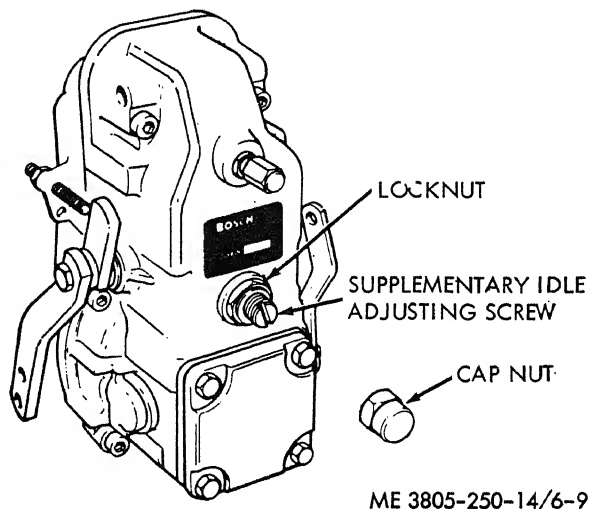


Figure 6-9. Supplementary idle screw adjustment.

(4) Checking Control Rod Movement. If the engine is hard to start and there is no exhaust smoke, the control rod may be sticking. Check as follows:

(a) Loosen and remove the cap nut (fig. 6-10).

(b) Place the throttle in the wide open position so the control rack is toward the full load position.

(c) Work the control rod from the cap end several times to relieve sticking.

(d) When the control rod works easily and smoothly, replace and tighten the cap nut.

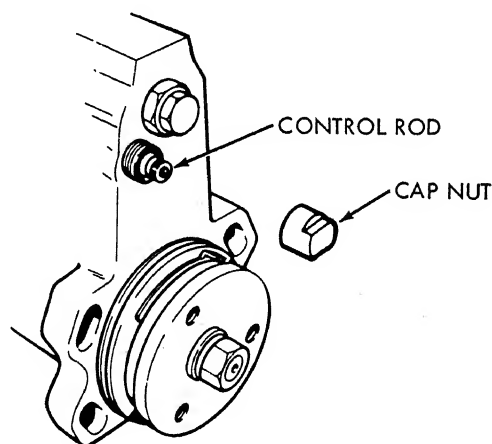


Figure 6-10. Control rod movement check.

(5) Low Idle Speed Adjustment. If low idle speed is less than 725 rpm or more than 775 rpm, adjust as follows:

(a) Remove the seal cap nut (fig. 6-11) and gasket, and loosen the locknut.

(b) Turn the low idle speed adjusting screw clockwise to increase speed or counterclockwise to decrease speed.

(c) Check the engine speed with each adjustment. At proper adjustment, tighten the locknut. Install the gasket and cap nut.

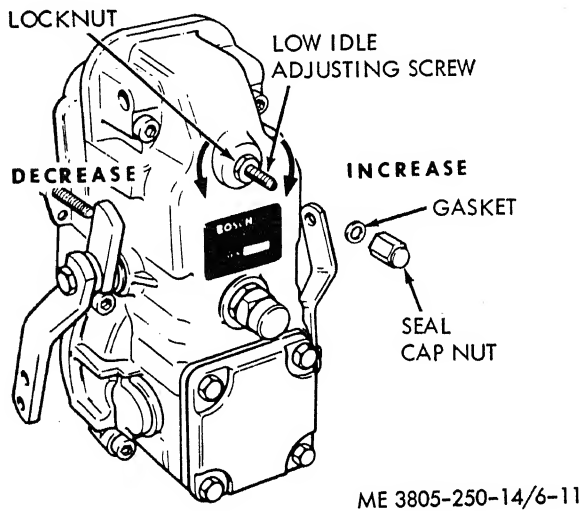


Figure 6-11. Low idle speed adjustment.

### 6-3. Fuel Injectors

#### a. Removal.

(1) Clean the cylinder head around the injectors and blow off with compressed air. Disconnect the leak-off line nuts (1, fig. 6-12) from the tee (2). Remove lines (3) and remove the tee from the injector.

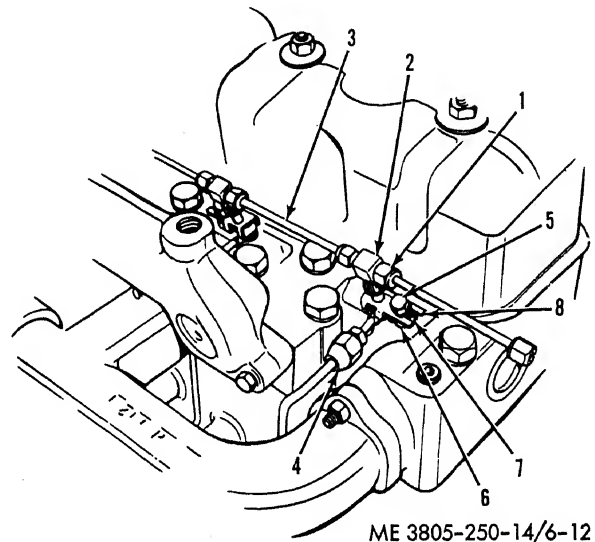
(2) Disconnect the injector inlet fitting (4).

(3) Loosen and remove the injector hold-down capscrew (5), clamp (6) and spacers (7). Do not remove locating plate (8).

**CAUTION:** Do not attempt to remove injector by prying. The body could be damaged.

(4) Remove the injector (9) from the cylinder head by pulling upward and turning. If necessary, use a puller.

(5) Install protective caps on the injector and plug the cylinder head opening.



- |             |                   |
|-------------|-------------------|
| 1. Nut      | 6. Clamp          |
| 2. Tee      | 7. Spacer         |
| 3. Line     | 8. Locating plate |
| 4. Fitting  | 9. Injector       |
| 5. Capscrew |                   |

Figure 6-12. Fuel injector, removal and installation.

**b. Disassembly.**

Note. The fuel injector tool kit (fig. 6-13) is used in

servicing and cleaning the injectors. Keep work area and tools clean. Handle parts carefully.

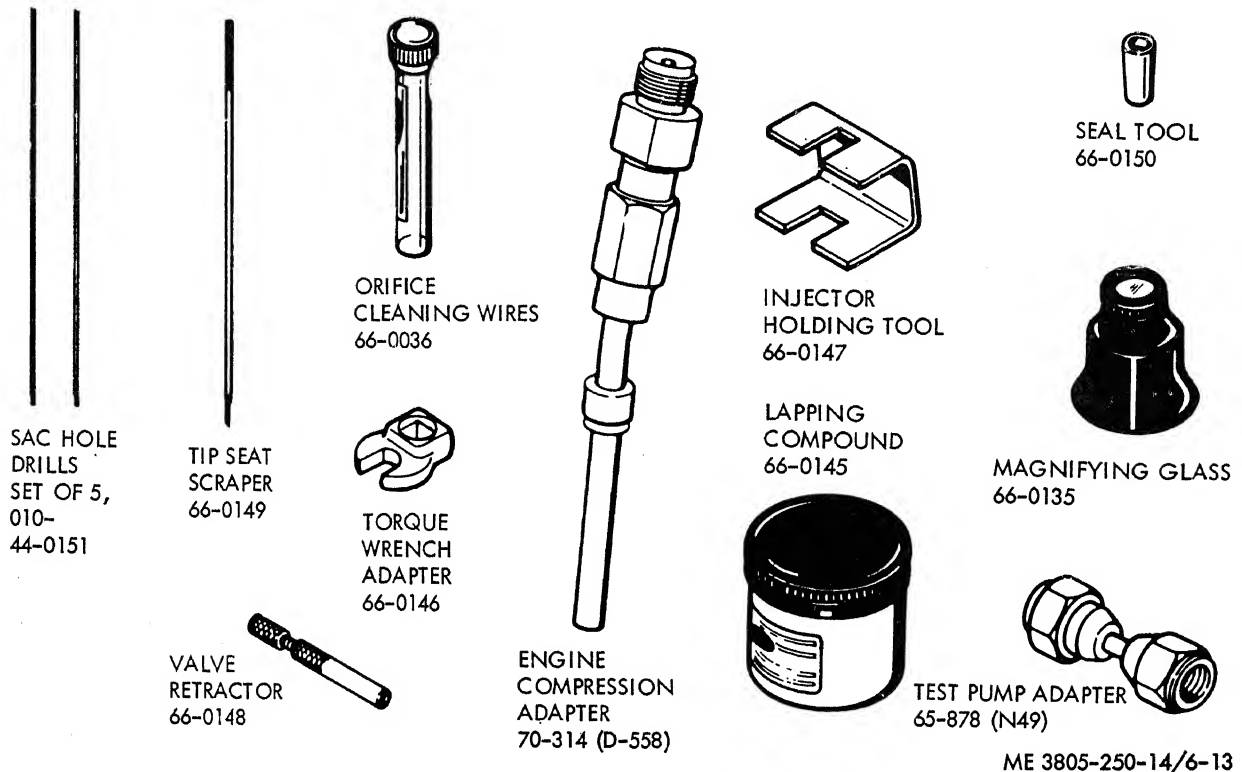


Figure 6-13. Fuel injector tool kit.

(1) Place the injector in the holding tool (66-0147) and secure the tool in a vise. Loosen the pressure adjusting screw locknut (1, fig. 6-14).

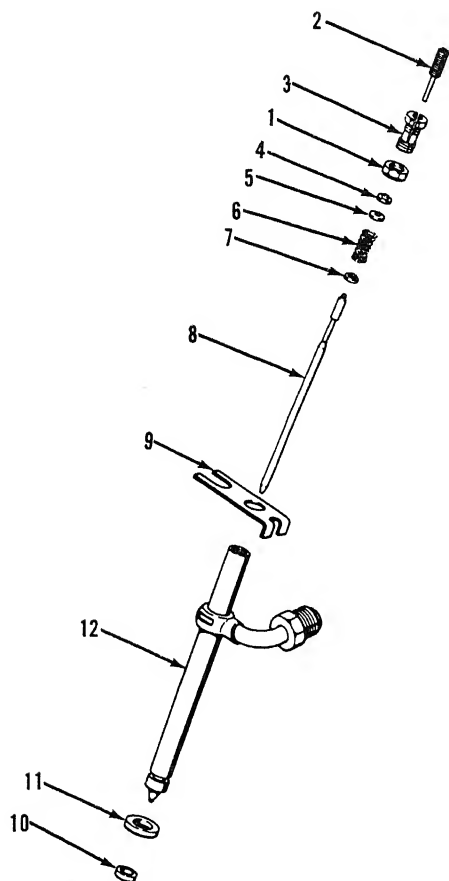
(2) Remove lift adjusting screw (2). Invert the injector and back out the pressure adjusting screw (3). Remove washer (4), upper seat (5), spring (6) and lower seat (7),

(3) If valve (8) does not slide out freely, remove valve with valve retractor (56-0148).

Bottom the valve in the body with the retractor. Push down on the retractor body to mount the collet. Turn the knurled knob counterclockwise to secure the collet, and withdraw the valve.

(4) Remove locating plate (9).

(5) Remove and discard carbon seal (10) and compression seal (11) from body (12).



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- |                             |                      |
|-----------------------------|----------------------|
| 1. Locknut                  | 7. Seat              |
| 2. Lift adjusting screw     | 8. Valve             |
| 3. Pressure adjusting screw | 9. Locating plate    |
| 4. Washer                   | 10. Carbon seal      |
| 5. Seat                     | 11. Compression seal |
| 6. Spring                   | 12. Body             |

Figure 6-14. Fuel injector, exploded view.

#### c. Cleaning, Inspection and Repair.

(1) Place all components in solvent to remove carbon deposits.

(2) Clean the injector body and tip with a brass wire brush. Clean carbon from spray orifices with 0.008, 0.009, and 0.010 inch diameter cleaning wires (fig. 6-13). Secure the wire in the pin vise with the wire protruding  $1/32$  inch to prevent the wire from breaking off in the sac hole.

(3) Replace injector if any orifices are chipped at the edges or eroded so that spray pattern is affected.

(4) Clean the seat in the tip with scraper tool (66-0149).

(5) Insert sac hole drill (66-0151) into the sac hole. Rotate to remove deposits.

(6) Inspect the valve for pitting or erosion which could cause leakage.

(7) Inspect the adjusting screws for thread damage and replace if necessary.

#### d. Reassembly.

(1) Clean parts thoroughly before assembling. Keep hands and all parts wet with clean fuel.

(2) Hold the valve by its shank and slide partially into the body.

(3) Install locating plate (9, fig. 6-14).

(4) Assemble washer (4), upper spring seat (5), spring (6) and lower spring seat (7) on pressure adjusting screw (3) and locknut (1). Install lift adjusting screw (2) in the pressure adjusting screw.

(5) Tilt the injector body and place the lower spring seat in contact with the valve. Carefully slide all components into the valve body. Tighten pressure adjusting screw 8 to 10 full turns until components are held in place.

(6) Test the injector (subpara e) and adjust as necessary (subpara f).

(7) Tighten locknut to a torque of 70 to 75 pound-inches. Install new compression seal (11) and carbon seal (10).

#### e. Testing.

(1) Prepare the injector test stand (65-0934), fig. 6-15) as follows:

(a) Fill the test stand fuel reservoir and loosen the bleeder screw.

(b) When the fuel flowing from the bleeder screw opening is free of air bubbles, tighten the screw.

(c) Wash the connector tube and adapter with clean diesel fuel. Blow clean with filtered compressed air and connect securely to the test stand.

(d) Slowly operate the hand lever until clean fuel flows from the adapter.

(2) Clean carbon deposits from the tip of the injector with a brass wire brush. Be careful not to scrape the Teflon coating above the carbon seal groove.

(3) Connect the injector to the test stand adapter, tip pointing down, as shown in figure 6-15.

**WARNING:** Always direct the injector tip away from the operator. Fuel from the orifices can penetrate the skin, causing serious infection. Enclose the tip in a transparent receptacle to contain the spray.

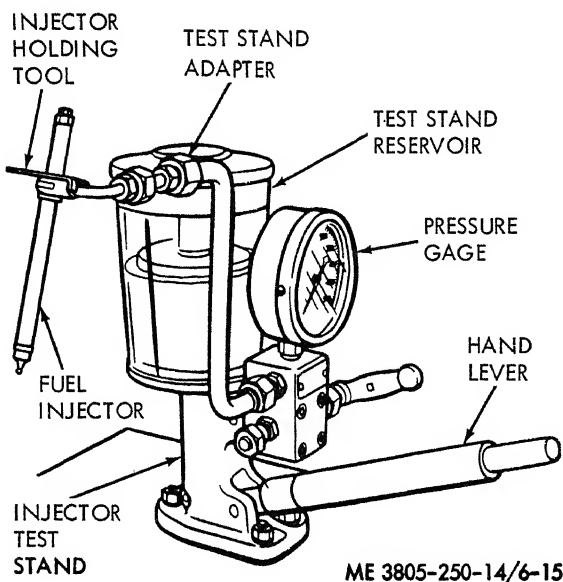


Figure 6-15. Injector test stand.

(4) Check injector opening pressure as follows:

(a) Close the pressure gage valve and flush the injector by operating the test pump rapidly.

(b) Open the gage and raise the pressure slowly until the injector valve opens. Opening pressure should be 2950 to 3050 psi for a new injector and 2750 to 2850 psi for a serviced injector.

*Note.* When testing several injectors from one engine, pressure readings must not differ by more than 100 psi.

(c) If injector does not meet opening pressure requirements, proceed as follows:

1. Adjust new injectors (subpara f).
2. Disassemble and clean used injectors.
3. Adjust valve lift screw (subpara f).
4. Check for broken or weak opening pressure control spring.

(5) Check seat leakage as follows:

(a) Operate the test pump rapidly to firmly seat the valve. Dry the injector tip.

(b) Raise the pressure at the injector to 2700 to 2800 psi for a new injector or 2500 to 2600 psi for a serviced injector.

(c) Check the injector tip. A drop of fuel should not form within 10 seconds.

*Note.* Slight dampness is permissible with a serviced injector.

(d) If a drop forms, proceed as follows:

1. Disassemble and clean injector.
2. Check valve to ensure it is free in guide.

If necessary, lap the valve to the guide. Refer to subparagraph g for lapping procedure.

3. Inspect for pitted or cracked valve tip, eroded valve seat, or pitted and distorted body. If any of these conditions exist, replace the complete injector assembly.

(6) Check the injector spray pattern as follows:

(a) Close the pressure gage.

(b) Operate the tester at 60 strokes per minute and observe the spray pattern. Fuel should be finely atomized (fig. 6-16) and not a solid irregular spray pattern (fig. 6-17).

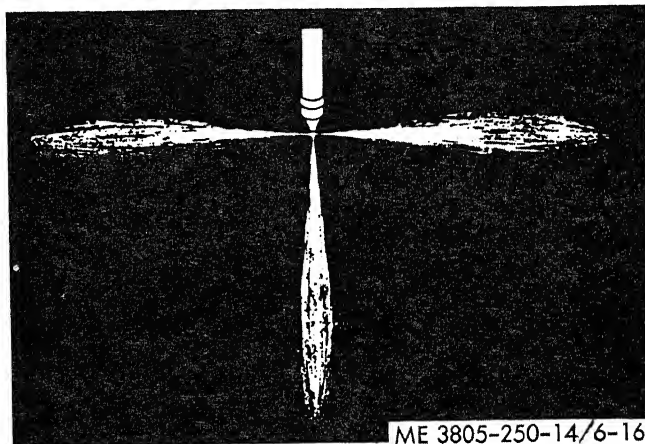


Figure 6-16. Fine atomized spray pattern.

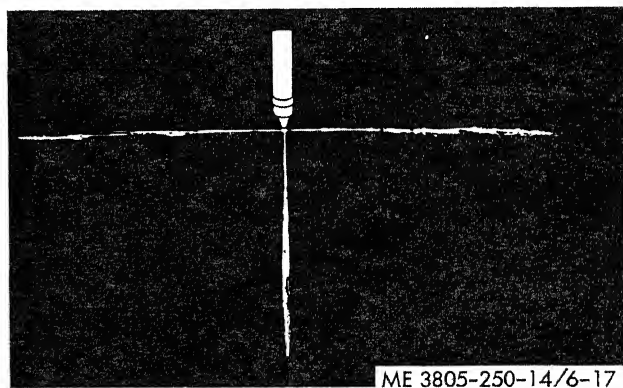


Figure 6-17. Solid irregular spray pattern.

*Note.* Chatter is an indication of valve freedom and will improve atomization. Chatter is also an indication of good seat width and interference angle conditions.

(c) If the injector produces a solid type irregular spray pattern, proceed as follows:

1. Check for eroded, clogged or chipped orifices.

2. Disassemble and clean injector.

3. Lap the valve to the guide. (Refer to subparagraph g for lapping procedure.)

4. Check for pitted or eroded valve or seat, worn valve interference angle, bent valve and distorted body. If any of these conditions exist, replace the complete fuel injector.

(7) Test injector leakoff as follows:

(a) Position the injector on the test stand with the tip slightly above a horizontal plane (fig. 6-18).

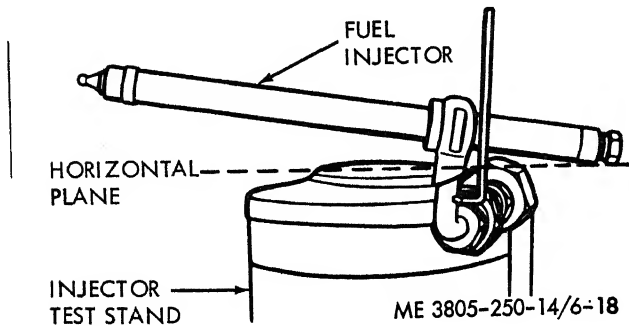


Figure 6-18. Leakoff test setup.

(b) Apply pressure of 1500 psi to the injector.

(c) Observe leakage from the return end of the injector. After one drop falls, leakoff should be 3 to 10 drops in 30 seconds with No. 2 diesel fuel at 65° to 75° F.

(d) If leakoff does not meet requirements, proceed as follows:

1. If leakoff is excessive, replace injector.
2. If leakoff is low, disassemble and clean injector and lap the valve to the guide. (Refer to subparagraph g for lapping procedure.)

f. Adjustment.

(1) Loosen the adjusting screw locknut and place the injector in the test stand as shown in figure 6-15.

(2) Adjust opening pressure as follows:

(a) Carefully turn the lift adjusting screw until it bottoms. Back off the lift adjusting screw far enough to prevent bottoming when the pressure adjusting screw is turned.

(b) Turn the pressure adjusting screw clockwise to increase opening pressure or counterclockwise to decrease pressure.

(3) Set valve lift as follows:

(a) Pump fuel through the injector. Hold the pressure adjusting screw and slowly turn the lift adjusting screw clockwise until the valve is fully open.

(b) Check for bottoming of the valve by applying a pressure of 3200 to 3500 psi to new injectors and 3000 to 3300 psi to serviced injectors.

Note. Some fuel may collect on the tip. A rapid dribble is not acceptable.

(c) Turn the lift adjusting screw counterclockwise to obtain a valve lift of  $\frac{3}{4}$  turn off the valve seat or 0.0135 inch.

(d) Hold the pressure adjusting screw and tighten the locknut to 70 to 75 pound-inches, using wrench 66-0146.

(e) Recheck the opening pressure.

g. Lapping. Lap the injector valve to the guide as follows. Lapping tools are a part of the fuel injector tool kit, figure 6-13.

(1) Disassemble the injector and flush the nozzle with solvent.

(2) Place a small amount of lapping compound on the valve seat and insert the valve onto the body. Grip the top of the valve with the retractor.

(3) Rotate the valve by hand, first clockwise, then counterclockwise a total of 3 to 5 revolutions.

(4) Flush the body with solvent and reassemble the injector.

(5) Retest the injector (subpara e). If the seat is tight but chatter is lost, replace the injector.

h. Installation.

(1) Install the injector on the cylinder head bore using a twisting motion. Do not lubricate.

(2) Install spacer (7, fig. 6-12), clamp (6), and capscrew (5) securing the locating plate (8). Hand tighten injector inlet fitting (4) to the tube. Tighten capscrew (5) to a torque of 20 pound-feet.

(3) Install tee (2) and connect leak-off line nuts (1).

(4) Crank the engine with the starter until the fuel flows from the loosened injector inlet fitting (4).

(5) Tighten the inlet fitting.

(6) Start the engine and check for leaks.

#### 6-4. Electric Fuel Pump

a. Removal. Refer to paragraph 4-16.

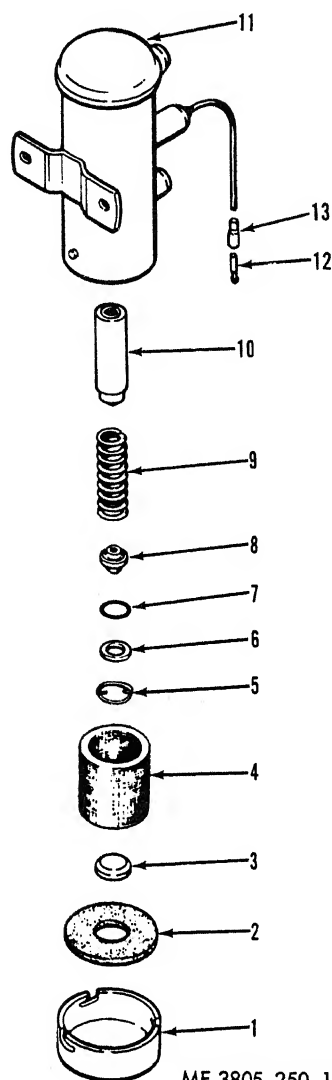
b. Disassembly. Refer to figure 6-19.

(1) Twist off pump cover (1).

(2) Remove the gasket (2), magnet (3), filter (4), preformed packing (5), retainer (6), washer (7), cup valve (8), spring (9) and plunger (10) from the body (11).

(3) If necessary, remove connector (12) and adapter (13).





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- |                      |               |
|----------------------|---------------|
| 1. Cover             | 8. Cup valve  |
| 2. Gasket            | 9. Spring     |
| 3. Magnet            | 10. Plunger   |
| 4. Filter            | 11. Body      |
| 5. Preformed packing | 12. Connector |
| 6. Retainer          | 13. Adaptor   |
| 7. Washer            |               |

Figure 6-19. Electric fuel pump, exploded view.

**c. Cleaning, Inspection and Repair.**

(1) Clean all components with solvent.

(2) Inspect the sliding surface of the plunger for grooves and scratches.

(3) Replace filter, preformed packing and gasket.

**d. Reassembly.** Assemble pump by reversing the disassembly procedure.

**e. Installation.** Refer to paragraph 4-16.

**6-5. Fuel Tank Repair**

**a.** Clean the tank with solvent.

**b.** Inspect the tank for leaks, cracks, dents, rust and corrosion. Repair tank as necessary.

**c.** Replace damaged lines, fittings and strainer.

## Section II. AIR INDUCTION AND EXHAUST SYSTEM

### 6-6. General

a. The air induction and exhaust system consists of the air cleaner, intake manifold, turbocharger, exhaust manifold, and exhaust pipe.

b. The turbocharger turbine converts exhaust gas energy into shaft or rotary power. The gas enters the turbocharger, flows around the housing, passes through the nozzle vanes, acts on and drives the turbine wheel, and is ducted to the exhaust pipe. Meanwhile, intake air enters the air compressor housing where a diffuser and blower wheel increase the air pressure, delivering air to the combustion chambers at a pressure greater than atmospheric pressure.

### 6-7. Turbocharger

a. *Removal.* Refer to figure 6-20.

(1) Remove the engine side panels, exhaust pipe (para 4-22) and hood (para 4-51).

(2) Disconnect the air compressor air inlet line from the air inlet elbow.

(3) Disconnect the oil inlet line and oil outlet line. Cap or plug openings.

(4) Remove four screws and disconnect the exhaust elbow from the turbocharger. Discard the gasket.

(5) Remove four self-locking nuts and washers securing the turbocharger to the exhaust manifold. Remove the turbocharger and discard the mounting gasket.

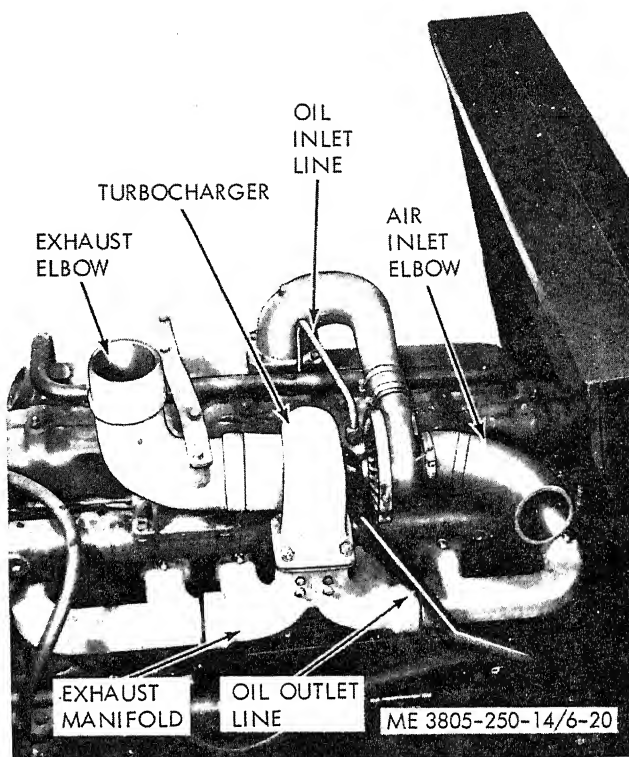


Figure 6-20. Turbocharger, removal and installation.

b. *Disassembly.*

(1) Clean the turbocharger exterior with solvent before disassembly.

(2) Remove clamp (1, fig. 6-21) that secures compressor housing (2) to the center housing (3). Remove the compressor housing, tapping with a soft hammer if necessary. Remove the diffuser (4).

(3) Oil the six capscrews (5) securing the turbine housing (6) to the center housing. Remove the capscrews and the turbine housing clamps and lockplates (7). Remove the turbine housing.

(4) Clamp the center housing assembly so that the shaft (8) cannot turn. Use a double universal joint and remove locknut (9). Be careful not to bend the shaft.

(5) Twist and pull the compressor impeller (10) off the shaft.

(6) Remove the center housing (3), backplate (11), and turbine shroud (12) as an assembly.

(7) Remove the seal ring (13) from the groove on the shaft.

(8) Remove four capscrews (14) and lockplates (15) securing the backplate to the center housing, and remove the backplate.

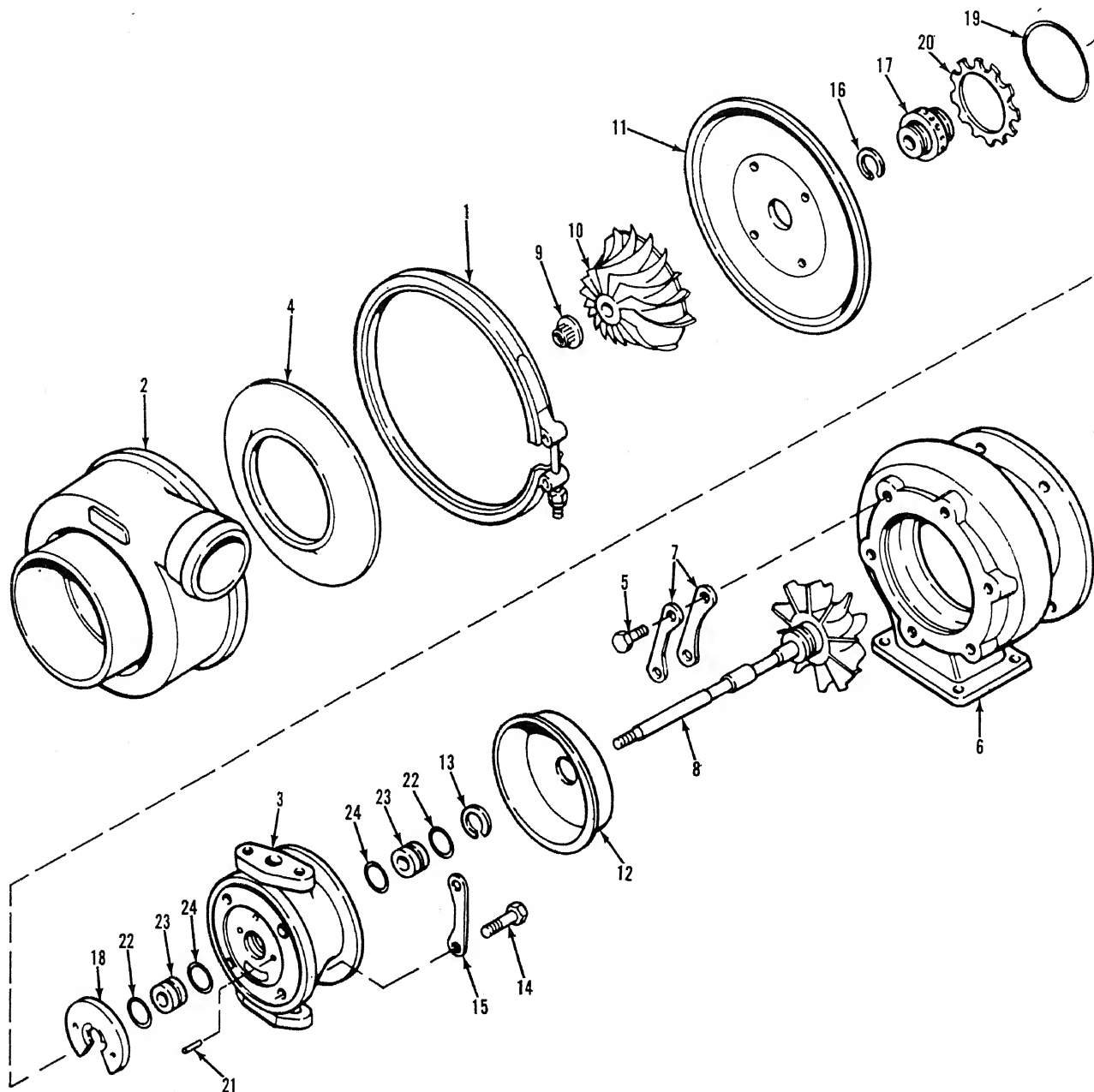
(9) Remove the seal ring (16), thrust collar (17), thrust bearing (18), rubber seal ring (19), and external tooth lockwasher (20).

(10) Remove spring pins (21) and twist out

the outer bearing retainers (22). Be careful not to score the bearing bore.

(11) Remove bearings (23).

(12) Remove inner bearing retainers (24).



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Figure 6-21. Turbocharger, exploded view.

KEY to fig. 6-21:

1. Clamp
2. Compressor housing
3. Center housing
4. Diffuser
5. Capscrew
6. Turbine housing
7. Clamp and lockplate
8. Shaft
9. Locknut
10. Impeller
11. Backplate
12. Shroud

*c. Cleaning, Inspection and Repair.*

*(1) Cleaning.*

(a) Soak the compressor impeller, compressor housing, backplate, diffuser, and turbine end in solvent. When deposits have softened, remove dirt with a stiff bristle brush.

(b) Soak bearings in a solution which will not react with aluminum.

(c) Blow out all oil passages and internal cavities in the center housing, thrust collar, and thrust bearing with compressed air.

*(2) Inspection.*

(a) Inspect all parts for signs of damage, corrosion, or deterioration. Inspect threads for nicks or stripped condition.

(b) Inspect the turbine wheel for signs of rubbing and vanes for wear or damage. Inspect the shaft for scoring, scratches, or seizure with the bearings.

(c) Inspect the impeller for cleanliness and signs of rubbing. The bore must not be galled. The fit should be 0.0002 inch tight to 0.0004 inch loose.

(d) Inspect seal parts for signs of rubbing or scoring of the running faces.

(e) Inspect housings for signs of contact with rotating parts. Oil and air passages must be clean and unobstructed.

(f) Measure bearing bore diameter. It must not be more than 0.0003 inch out-of-round or exceed 0.6228 inch ID.

(g) Measure impeller shaft bearings. The ID must not exceed 0.4019 inch and the OD must not be less than 0.6182 inch.

(h) Measure thrust bearing thickness at three places along the collar bore. Thickness must be between 0.1711 and 0.1720 inch.

(i) Measure backplate bore for an ID not to exceed 0.5015 inch.

(j) Inspect the thrust collar for warped or scored faces. The ring groove shoulders must be free of slip wear. The bearing area width should not exceed 0.1758 inch, and the ring groove width should not exceed 0.0665 inch. Clearance between the thrust collar and thrust plate should be between

13. Seal ring
14. Capscrew
15. Lockplate
16. Seal ring
17. Thrust collar
18. Thrust bearing
19. Rubber seal ring
20. External tooth lockwasher
21. Spring pin
22. Outer bearing retainer
23. Bearing
24. Inner bearing retainer

0.001 and 0.004 inch, measured at three places with a feeler gage.

(k) Shaft journals must not be more than 0.0003 inch out-of-round, and the diameter must not be less than 0.3992 inch. The sealing ring groove walls must not be slip-worn. The sealing ring hub OD must be between 0.682 and 0.683 inch. The ring groove width must be between 0.0645 and 0.0665 inch.

(l) Measure the shaft end play and radial movement (subparagraph e). End play must be between 0.001 and 0.0042 inch. Radial movement must not exceed 0.007 inch.

*(3) Repair.*

(a) Burnish or polish out minor surface damages with abrasive cloths.

(b) Replace any component which does not meet the inspection tolerance requirements.

(c) Replace all seal rings and lockplates.

(d) Replace damaged bolts and capscrews.

*d. Reassembly.*

(1) Install new bearing retainers (24 and 22, fig. 6-1) in center housing (3).

(2) Oil the shaft bearings (23) and install the bearings and spring pins (21).

(3) Install a new metallic seal (13) on the shaft (8), and place the turbine shroud (12) on the shaft.

(4) Oil the shaft journals and place the center housing over the shaft. Press down to seat the seal (13). Rotate the housing to check for proper seating.

(5) Install a new seal ring (16) on the thrust collar (17). Insert the thrust collar in the thrust bearing (18) so that the seal ring end of the collar is on the smooth side of the bearing.

(6) Install the thrust bearing and collar assembly in the center housing. Press down to seal.

(7) Install a new rubber seal ring (19) and an external tooth lockwasher (20).

(8) Install the backplate (11), using care not to damage seal ring (18). Install lockplate (15) and tighten capscrews (14) to a torque of 40 to 60 pound-inches. Bend up the locking tabs.

(9) Twist the compressor impeller (10) onto the shaft until it bottoms against the thrust collar.

(10) Oil the threads of locknut (9) and install on the end of the shaft. Tighten to a torque of 18 to 20 pound-inches, then tighten an additional  $\frac{1}{4}$  turn.

(11) Install the turbine housing (6) and clamps and lockplates (7). Tighten capscrews (5) to a torque of 100 to 130 pound-inches. Bend up the locking tabs.

(12) Check the end play and shaft radial movement (subpara e).

(13) Align the diffuser (4) legs with the spot faces on the backplate, and install the diffuser.

(14) Install the compressor housing (2) and secure with clamp (1). Tighten clamp screw to 40 to 80 pound-inches

*e. Shaft End Play and Radial Movement Check.*

(1) Remove the compressor housing and turbine housing. Refer to subparagraph b.

(2) Check shaft end play as follows:

(a) Clamp the turbine housing flange (fig. 6-22) in a vise.

(b) Using a clamp or magnetic base dial indicator, place the indicator contact point on the end of the impeller shaft.

(c) Press up on the turbine wheel to force the impeller to the extreme up position. Record the indicator reading.

(d) Press down on the impeller and again record the indicator reading.

(e) Repeat (c) and (d) at least three times. The difference between the two readings is the shaft end play. End play should be between 0.001 and 0.0042 inch.

(f) If end play exceeds 0.0042 inch, the thrust collar bearing or backplate assembly is worn. If end play is less than 0.001 inch, check for a carbon buildup behind the turbine wheel.

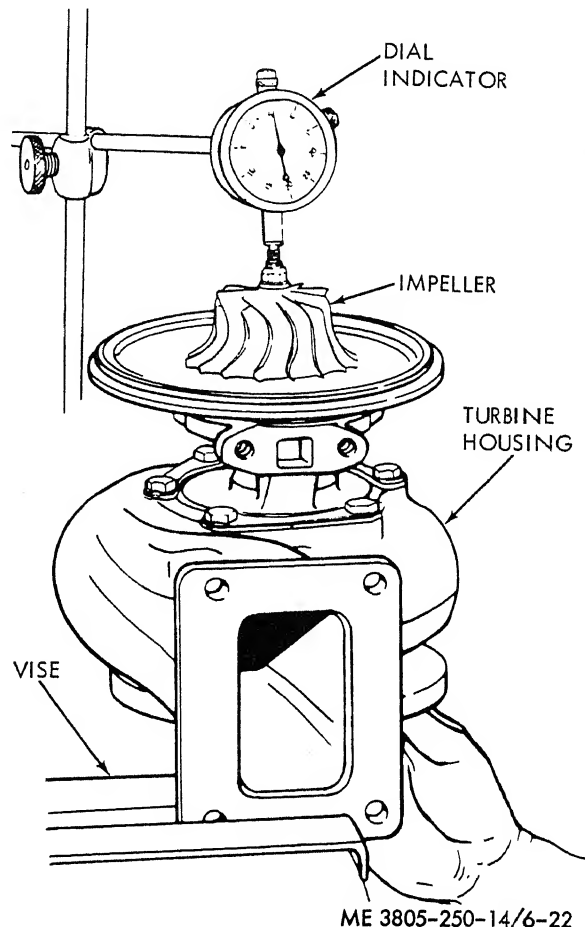


Figure 6-22. Shaft end play measurement.

(3) Check the shaft radial movement as follows:

(a) Fabricate a dial indicator adapter (fig. 6-23) by threading the end of a  $\frac{3}{8}$  by 8 inch rod. Secure to the turbine housing with a spindle clamp. Attach the dial indicator and extensions to the adapter.

(b) Insert the point of the dial indicator through the oil discharge outlet and place on the center of the impeller shaft.

(c) With one hand on the compressor wheel and one hand on the turbine wheel, pull the shaft up against the indicator. Record the indicator reading.

(d) With one hand on the impeller and one hand on the turbine wheel, push the shaft down, away from the indicator. Record the indicator reading.

(e) Repeat (c) and (d) at least three times. The difference between the readings of (c) and (d) is the shaft radial movement.

(f) If shaft radial movement exceeds 0.007 inch, the shaft, bearing or bearing bore is worn.

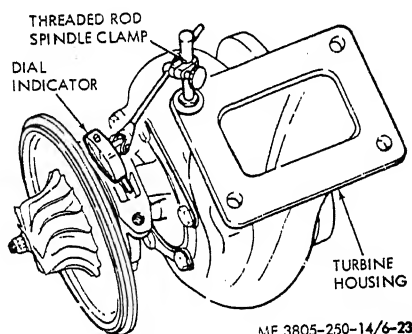


Figure 6-23 Radial movement measurement.

**f. Installation.**

(1) Service the air cleaner (para 3-8).

(2) Replace the lubricating oil filter elements (para 4-13). Change the engine oil (para 3-7).

(3) Inspect the turbocharger oil lines for cleanliness before installing the turbocharger.

(4) Install a new mounting gasket and position the turbocharger on the exhaust manifold (fig. 6-20). Secure with four self-locking nuts and washers.

(5) Position the exhaust elbow and new gasket on the turbocharger and secure with four screws.

(6) Install the hood (para 4-51) and exhaust pipe (para 4-22).

(7) Clamp the exhaust pipe to the exhaust elbow.

(8) Connect the oil inlet line and oil outlet line.

(9) Connect the air compressor air inlet line to the air outlet elbow.

(10) Pull out the fuel shutoff control and crank the engine for 30 seconds to lubricate the turbocharger.

(11) Run the engine at low idle and check turbocharger operation.

(12) Install the engine side panels.

**6-8. Exhaust Manifold**

**a. Removal.** Refer to figure 6-24.

(1) Remove the turbocharger (para 6-7).

(2) Remove twelve screws and washers securing the three exhaust manifold sections to the engine. Discard the six mounting gaskets.

(3) Separate the three manifold sections. Remove the pipe plug from the center section.

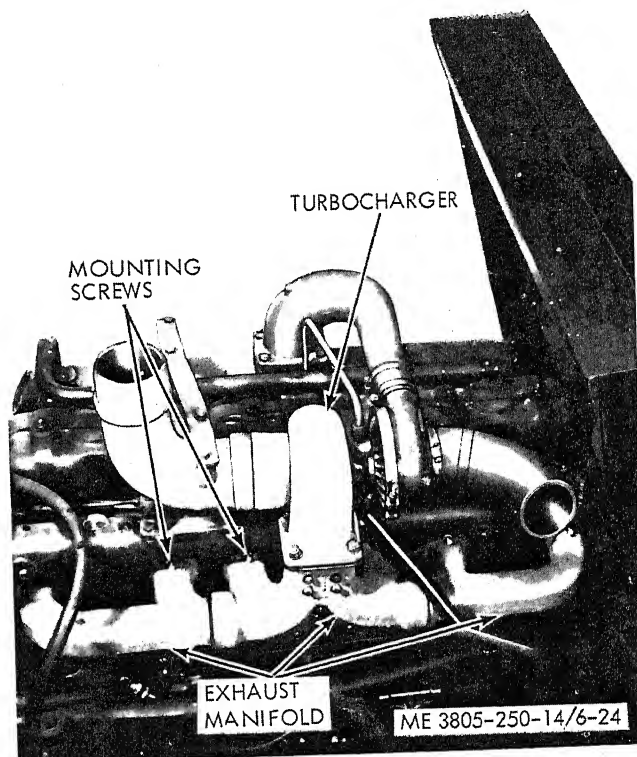


Figure 6-24. Exhaust manifold, removal and installation.

**b. Cleaning, Inspection and Repair.**

(1) Clean manifold sections with solvent.

(2) Inspect housings for cracks, chips, distortion, or other damage which could cause leaks.

(3) Replace all packings.

**c. Installation.**

(1) Install the manifold by reversing the removal procedure.

(2) Tighten screws to a torque of 68 to 73 pound-feet.

(3) Install the turbocharger (para 6-7).

(4) Start the engine and allow to reach operating temperature.

(5) Again tighten the manifold mounting screws to a torque to 68 to 73 pound-feet.

### Section III. ENGINE LUBRICATION SYSTEM

#### 6-9. General

The engine lubrication system provides pressure lubrication to all parts of the engine. The system consists of an oil pan, a gear-driven oil pump, an oil cooler and filter assembly, breather, and hose and tubes.

#### 6-10. Oil Cooler and Oil Filter Assembly

a. *Removal.* Refer to figure 6-25.

(1) Open the engine side panel.

(2) Open the drain cock on the oil cooler. Drain the oil pan.

(3) Disconnect the turbocharger oil tube from the filter head.

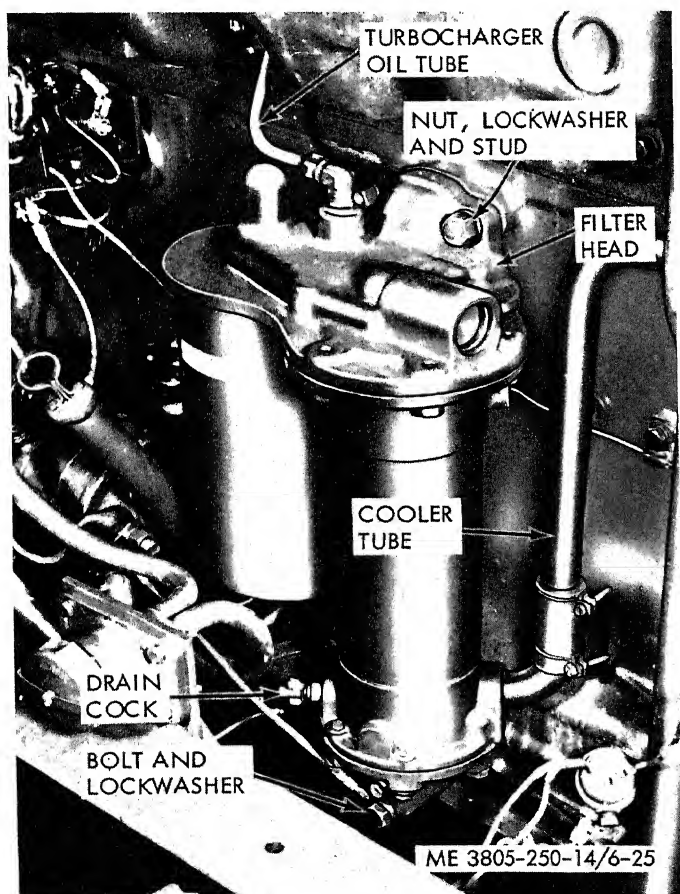


Figure 6-25. Oil cooler and oil filter assembly, removal and installation.

(4) Remove the two bolts and lockwashers securing the cooler tube to the engine block. Discard the mounting gasket.

(5) Remove two bolts and lockwashers securing the base of the cooler to the engine block. Discard preformed packings.

(6) Remove two nuts, lockwashers, and studs securing the filter head to the engine block. Discard the mounting gasket.

(7) Move the assembly to a clean work area.

b. *Disassembly.* Refer to figure 6-26.

(1) Remove the oil filter (1) by turning in a counterclockwise direction. Remove the threaded adapter (2).

(2) Remove two clamps (3), tube (4) and hose (5).

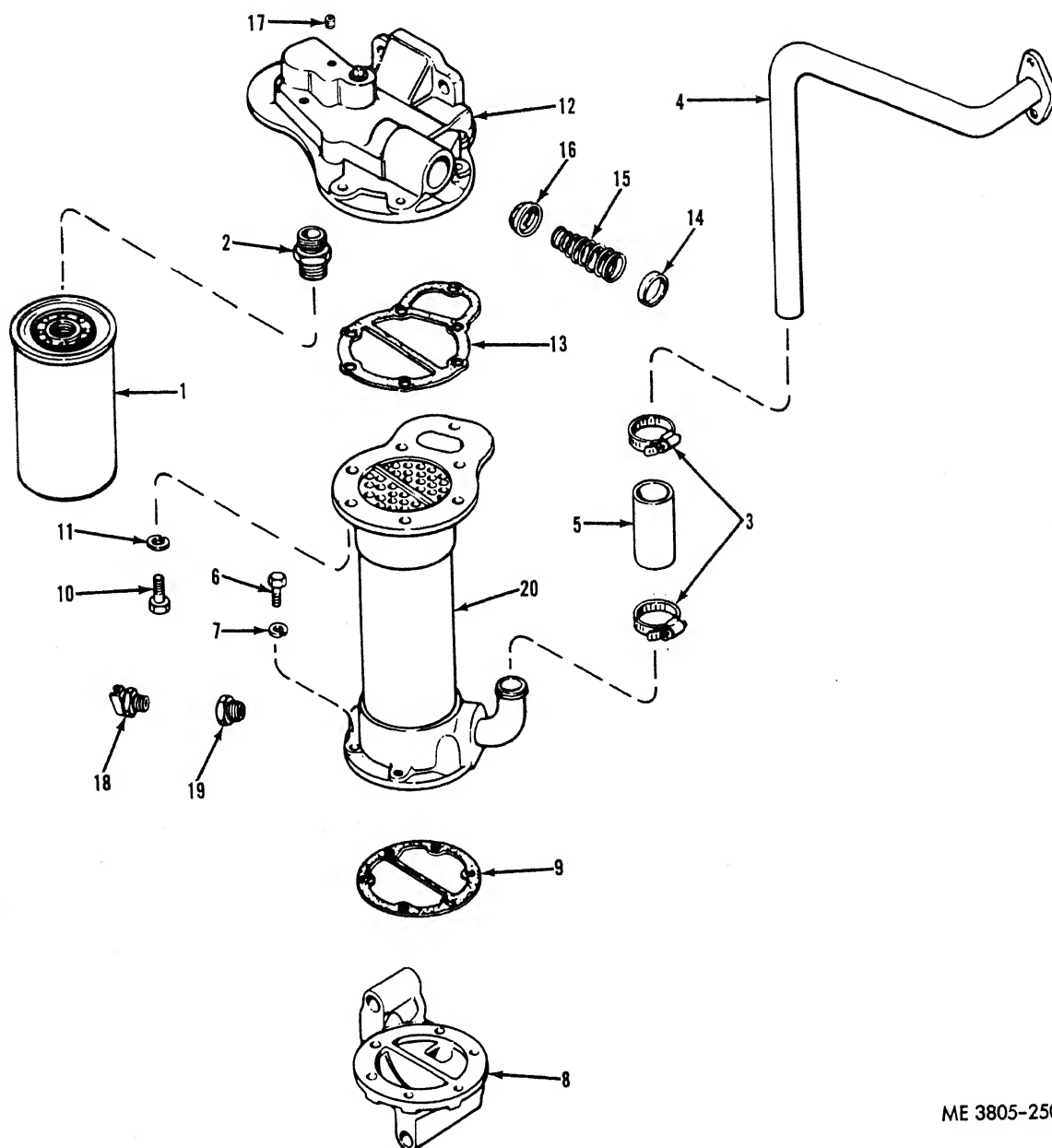
(3) Remove five bolts (6) and lockwashers (7) securing the base (8) to the oil cooler body. Discard gasket (9).

(4) Remove seven bolts (10) and lockwashers (11) securing the head (12) to the body. Discard gasket (13).

(5) Remove the cup plug (14), spring (15) and relief valve (16) from the head. Remove the plug (17).

(6) Remove the drain cock (18) and bushing (19) from the oil cooler body (20).





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- |                |                 |
|----------------|-----------------|
| 1. Filter      | 11. Lockwashers |
| 2. Adapter     | 12. Head        |
| 3. Clamps      | 13. Gasket      |
| 4. Tube        | 14. Plug        |
| 5. Hose        | 15. Spring      |
| 6. Bolts       | 16. Valve       |
| 7. Lockwashers | 17. Plug        |
| 8. Base        | 18. Drain cock  |
| 9. Gasket      | 19. Bushing     |
| 10. Bolts      | 20. Body        |

Figure 6-26. Oil cooler and oil filter assembly, exploded view.

*c. Cleaning, Inspection and Repair.*

- (1) Clean all components in solvent.
- (2) Inspect base, body and head for cracks, chips, dents or other damage which could result in leaks.
- (3) Inspect threaded components for thread damage and replace as necessary.
- (4) Inspect spring for cracked or weak condition.
- (5) Inspect tubes and fittings for damage and leaks.

*d. Reassembly.* Assemble oil cooler and oil filter assembly by reversing the disassembly procedure. Observe the following:

- (1) Tighten bolts (6 and 10, fig. 6-26) to a torque of 35 to 42 pound-feet.
- (2) Apply a thin coat of grease and install a new oil filter (1).

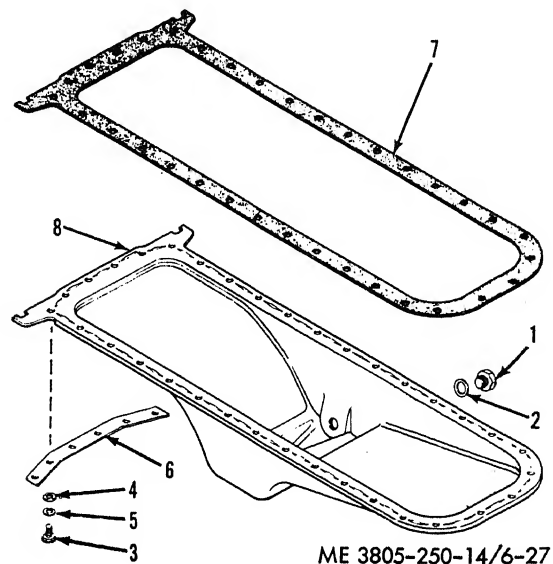
*e. Installation.*

- (1) Install oil cooler and oil filter assembly by reversing the removal procedure. Tighten mounting nuts and bolts to a torque of 80 to 96 pound-feet.
- (2) Close all drain cocks on the engine block, radiator and oil cooler. Service the system with coolant.
- (3) Install the oil pan plug and add new engine oil (para 3-7).
- (4) Start the engine and run for 10 to 15 minutes and check for leaks. Shut off the engine and check the level of coolant and oil. Add as necessary.
- (5) Install the engine side panel.

## 6-11. Oil Pan

*a. Removal.* Refer to figure 6-27.

- (1) Remove the oil pan drain plug (1) and gasket (2) and drain the oil from the pan.
- (2) Remove the engine (para 5-7).
- (3) Remove 32 bolts (3), washers (4), and lockwashers (5) securing the oil pan to the block, and remove the oil pan (8) and reinforcement (6). Discard gasket (7).



- |           |                  |
|-----------|------------------|
| 1. Plug   | 5. Lockwasher    |
| 2. Gasket | 6. Reinforcement |
| 3. Bolt   | 7. Gasket        |
| 4. Washer | 8. Oil pan       |

Figure 6-27. Oil pan, exploded view.

*b. Cleaning, Inspection and Repair.*

- (1) Inspect for chips, cracks, or other damage.
- (2) Clean pan thoroughly with solvent.
- (3) Replace gaskets.

*c. Installation.* Install oil pan by reversing the removal procedure. Tighten bolts to 13 to 17 pound-feet. Fill the crankcase with oil (para 3-7).

## 6-12. Oil Pump

*a. Removal.*

- (1) Drain the oil from the oil pan and remove oil pan (para 6-11).
- (2) Remove the oil pump suction tube (fig. 6-28).

(3) Remove two bolts securing the oil pump to the bearing cap. Remove the oil pump, shims, and preformed packing.

*Note.* Keep the shims together for proper installation.

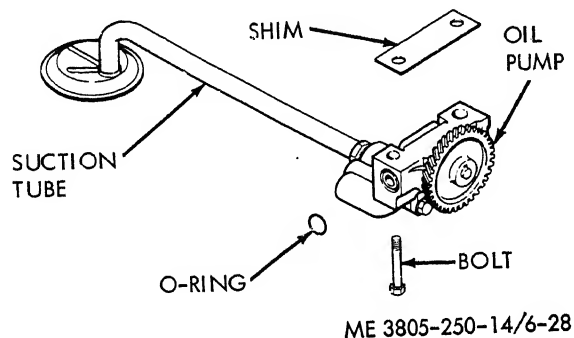


Figure 6-28. Oil pump, removal and installation.

*b. Disassembly.*

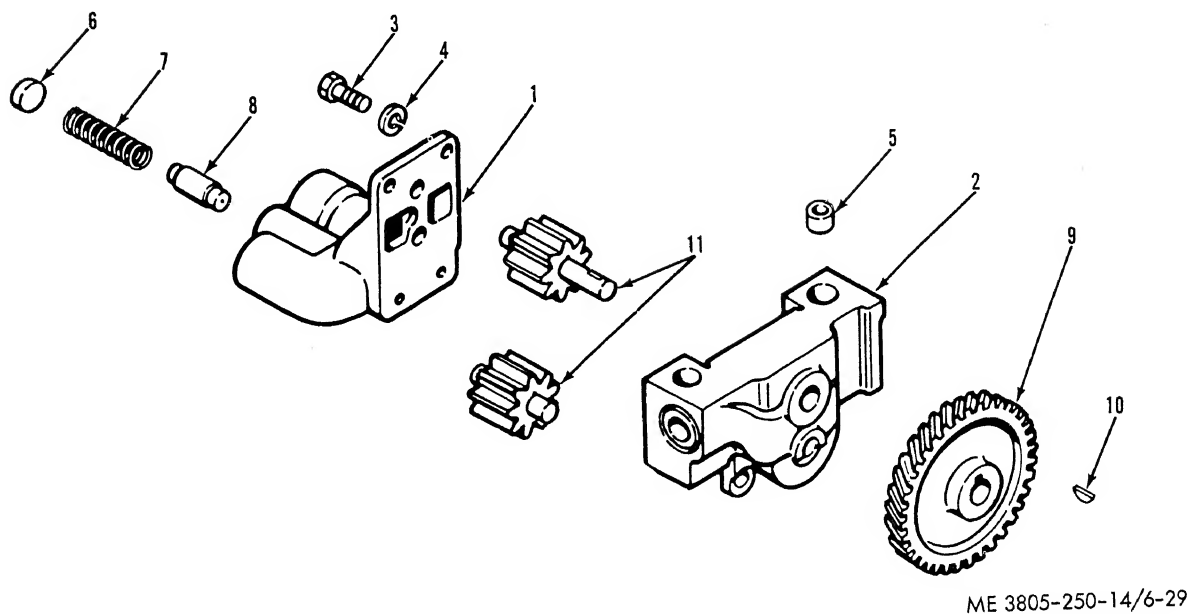
(1) Remove the pump cover (1, fig. 6-29) from the pump body (2) by removing four screws (3) and lockwashers (4).

(2) Remove the body sleeve (5).

(3) If necessary, remove the cup plug (6), relief valve spring (7) and relief valve (8) from the cover.

(4) Press the pump drive gear (9) from the shaft and remove the Woodruff key (10).

(5) Remove the gear and shaft assembly (11).



1. Pump cover
2. Body
3. Screw
4. Lockwasher
5. Sleeve
6. Cup plug

7. Spring
8. Relief valve
9. Drive gear
10. Woodruff key
11. Gear and shaft assembly

Figure 6-29. Oil pump, exploded view.

*c. Cleaning, Inspection and Repair.*

- (1) Clean all parts with solvent.
- (2) Inspect for nicks, burrs, cracks, or other damage. Small nicks or burrs may be removed with a hone or crocus cloth.
- (3) Inspect for wear. If any components are excessively worn, replace the pump.
- (4) Inspect the relief valve spring for the following:
  - (a) Twelve total coils.
  - (b) Wire thickness 0.071 inch.
  - (c) Minimum inside diameter 0.469 inch.
  - (d) Free length 2.06 inches.
  - (e) Compress to 1.252 inches with 17.25 to

19 pounds pressure.

(5) Place the gear and shaft assembly in the pump body and use a feeler gage to check radial clearance for 0.002 to 0.006 inch. If clearance exceeds 0.006 inch, replace pump.

(6) Place a strip of plastic gage on top of the gear and shaft assembly over the opening for the cover. Install the cover and tighten bolts to a torque of 17 to 20 pound-feet. Remove the cover and check the clearance between cover and gear. If clearance exceeds 0.005 inch, replace pump.

*d. Reassembly.* Refer to figure 6-29.

- (1) Install the gear and shaft assembly (11) into the pump body (2).
- (2) Install the cover (1) on the body and tighten screws (3) to a torque of 17 to 20 pound-feet.
- (3) Position the Woodruff key (10) on the shaft and press the pump drive gear (9) onto the shaft.

*Note.* Ensure that clearance between the pump drive gear and the pump body is 0.0035 to 0.0065 inch.

- (4) If cup plug (6) was removed, install the relief valve (8) and new spring (7). Install the new

cup plug (6) to a depth of 0.423 inch. Retain with a cotter pin.

(5) Install the sleeve (5, fig. 6-29) so that it protrudes 0.115 to 0.155 inch above the mounting face of the pump.

*e. Installation.*

(1) Install shims and position the oil pump against the engine block. Secure with two bolts tightened finger-tight. Check for clearance between the pump gear and crankshaft gear. Rotate the oil pump shaft 180° and again check for clearance.

(2) If no clearance exists between the gears, remove the pump and install additional shims as required to keep the gear teeth from binding.

(3) Tighten the pump mounting bolts to a torque of 145 to 155 pound-feet and check the gear backlash with a dial indicator. Backlash must be between 0.007 and 0.012 inch. Add or remove shims as required.

(4) Install the suction tube and tighten to a torque of 95 to 105 pound-feet.

(5) Install the oil pan (para. 6-11) and service the system.

### 6-13. Oil Lines and Fittings

*a. Removal.* Disconnect clamps and screws securing oil lines to the various loader components, and remove the lines.

*b. Cleaning, Inspection and Repair.*

(1) Inspect hose and lines for cracks and deterioration. Replace defective lines.

(2) Inspect lines for cleanliness and restrictions. Clean with solvent.

(3) Replace defective fittings.

*c. Installation.* Install oil lines by reversing the removal procedure. Use new gaskets or preformed packings. Start the engine and check for leaks.

## Section IV. COOLING SYSTEM

### 6-14. General

*a.* The engine cooling system consists of the cooling fan, radiator, water pump, thermostats, and lines and fittings. Coolant from the radiator is circulated by the water pump through the oil cooler and into the engine block. The coolant passes through the block and cylinder head and out through the thermostat housing. When the engine is below operating temperature, the thermostats are closed, preventing the coolant from returning to the radiator.

*b.* When the engine reaches operating temperature, the thermostats open to allow the coolant to flow through the radiator. A stream of air drawn across the radiator by the fan cools the liquid.

### 6-15. Water Pump

*a. Removal.*

(1) Drain the cooling system and remove the radiator (para 6-16).

(2) Loosen the alternator adjusting strap bolt (1, fig. 6-30) and remove the fan belts (2).

(3) Remove four bolts and lockwashers securing the fan to the pulley, and remove the fan.

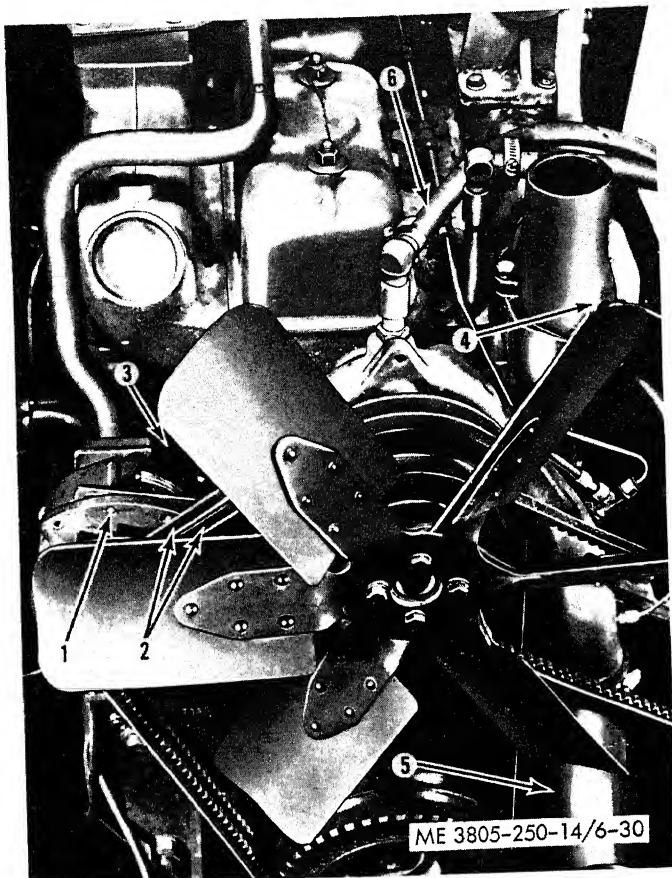
(4) Disconnect the oil cooler line (3) and discard the gasket.

(5) Disconnect the clamp securing the bypass hose (4) to the water pump housing.

(6) Disconnect the clamp securing the lower radiator hose (5) to the housing.

(7) Disconnect the air compressor line (6).

(8) Remove four bolts and lockwashers, and one washer and spacer securing the pump housing to the block. Remove the pump and discard the mounting gasket.



- |                                    |                        |
|------------------------------------|------------------------|
| 1. Alternator adjusting strap bolt | 4. Bypass hose         |
| 2. Fan belts                       | 5. Lower radiator hose |
| 3. Oil cooler line                 | 6. Air compressor line |

*Figure 6-30. Water pump, removal and installation.*

*b. Disassembly.* Refer to figure 6-31.

(1) Remove the nut (1) and washer (2) securing the pulley (3) to the pump housing (4). Use a puller to remove the pulley from the pump shaft.

(2) Remove four nuts (5), lockwashers (6) and studs (7) securing the pump (8) to the housing. Discard the mounting gasket (9).

(3) Remove the plug (10) from the rear of the pump housing.

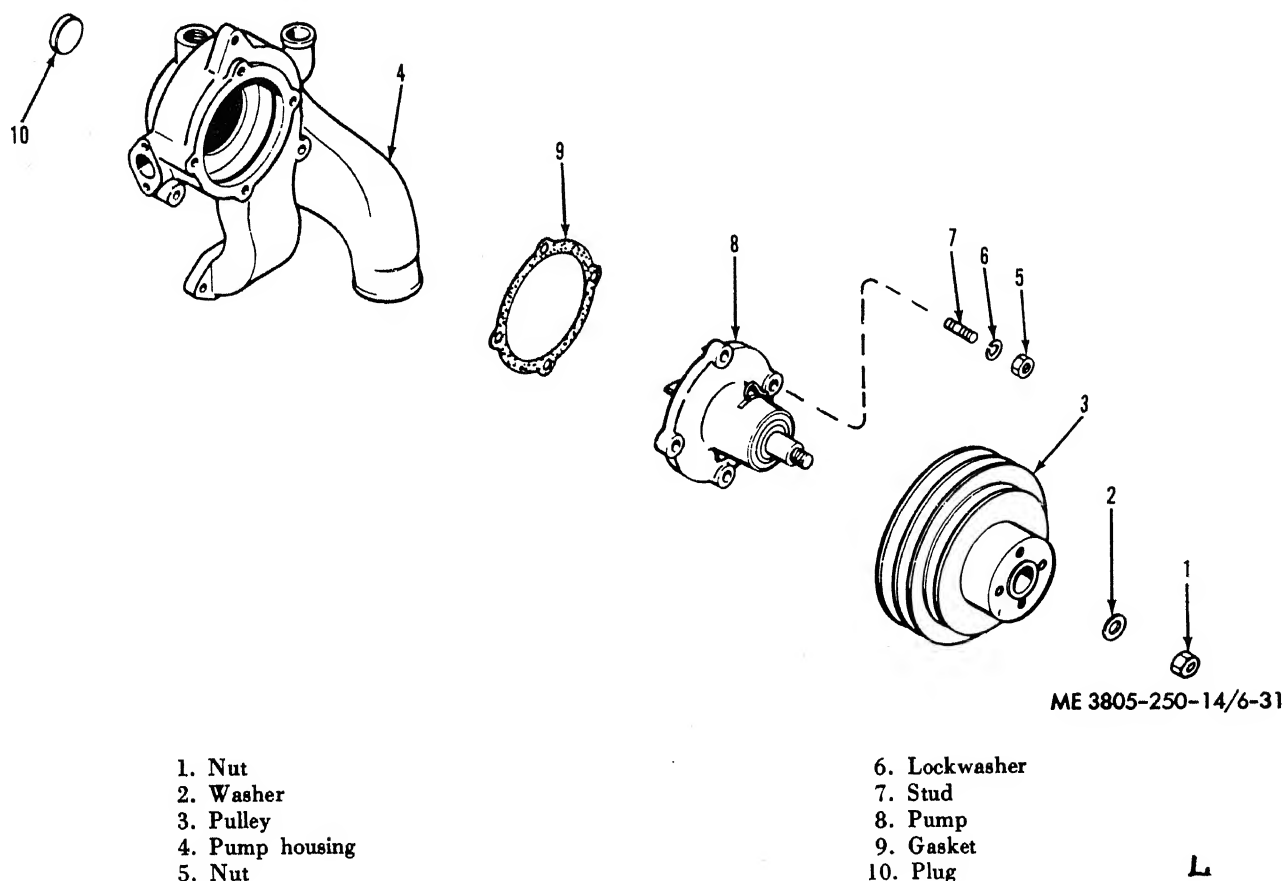


Figure 6-31. Water pump, exploded view.

**c. Cleaning, Inspection and Repair.**

- (1) Check housing for cracks at mounting flanges. Replace as necessary.
- (2) Check fan belts for wear, cracks, and fraying. Replace the belts as a set.
- (3) Check hose for cracks and deterioration. Replace as necessary.
- (4) Check impeller for dents, bends and other damage. Straighten or replace if badly damaged.
- (5) Inspect bearing for scored or out-of-round condition.

- (6) Replace all gaskets.

**d. Reassembly.** Assemble by reversing the disassembly procedure.

**e. Installation.** Refer to figure 6-30.

- (1) Install the water pump housing and new gasket to the block. Tighten mounting bolts evenly to 25 to 42 pound-feet.
- (2) Install the lower radiator hose (5) and secure with clamp.
- (3) Connect the air compressor line (6).
- (4) Connect the oil cooler line (3) and new

gasket. Tighten bolts to a torque of 17 to 20 pound-feet.

- (5) Install the bypass hose (4) and secure with clamp.

- (6) Install the fan belts and adjust as described in paragraph 4-27.

- (7) Install the radiator (para 6-16) and fill the cooling system. Check connections for leaks.

**6-16. Radiator**

**a. Removal.**

- (1) Remove the engine side panels and hood (para 4-51).
- (2) Drain the cooling system.
- (3) Remove four bolts, nuts, and lockwashers securing the sides of the radiator to the support (fig. 6-32).
- (4) Disconnect the clamps securing the upper radiator hose to the water manifold and the lower radiator hose to the water pump housing.
- (5) Lift and guide the radiator from the loader.

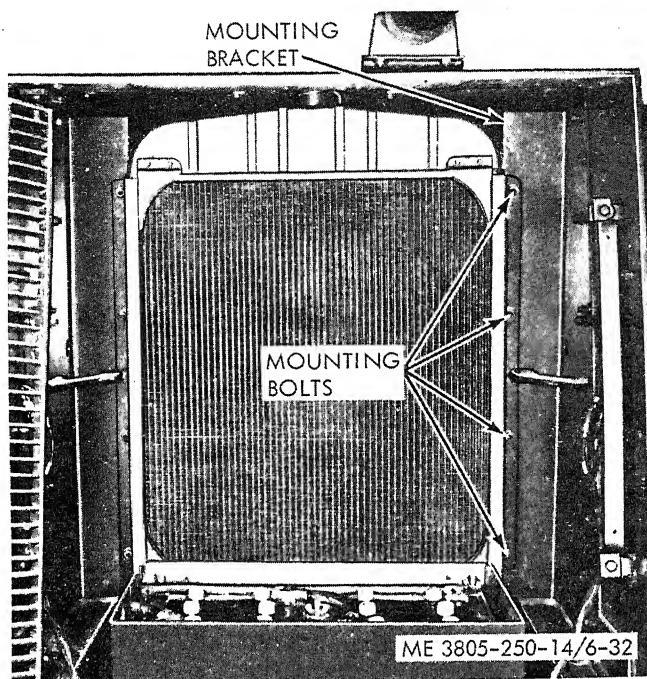


Figure 6-32. Radiator, removal and installation.

**b. Cleaning, Inspection and Repair.**

- (1) Clean the radiator with cleaner and flush with water.
- (2) Inspect radiator surfaces for signs of

corrosion, dents or other damage which could cause leaks.

(3) Check hose for cracks and deterioration and replace as necessary.

(4) Inspect the cap for damage and wear and replace as necessary.

**c. Installation.** Install the radiator by reversing the removal procedure, using care not to damage the fan. Service the system (para 2-1) and start the engine to check for leaks. Install the hood (para 4-51) and engine side panels.

**6-17. Fan Assembly**

**a. Removal.**

(1) Drain the cooling system and remove the radiator (para 6-16).

(2) Remove four mounting bolts and lockwashers, and remove the fan from the water pump.

**b. Cleaning, Inspection and Repair.**

(1) Clean the fan with solvent.

(2) Inspect fan blades for bends or dents.

Straighten blades that are out of alignment.

(3) Check fan blades to ensure they are held securely in position.

**c. Installation.**

(1) Install the fan by reversing the removal procedure.

(2) Install the radiator (para 6-16) and service the cooling system (para 2-1).

**Section V. ENGINE COMPONENTS**

**6-18. General**

**a.** The engine is a six-cylinder turbocharged diesel unit. It has a displacement of 504 cubic inches and an output of 157 horsepower at 2200 rpm.

**b.** Maintenance of some of the engine components may be performed with the engine installed in the loader. In this case, remove the hood (para 4-51) and radiator (para 6-16) for access to the engine. For maintenance with the engine removed from the loader, refer to paragraph 5-7 for engine removal.

**6-19. Rocker Arm Assembly**

**a. Removal.**

- (1) Steam-clean the engine.

(2) Remove the crankcase breather tube (para 4-14).

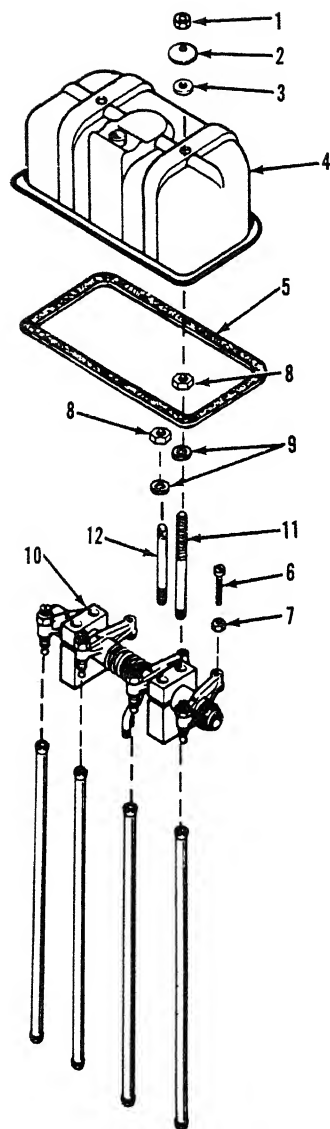
(3) Remove six nuts (1, fig. 6-33), washers (2) and gaskets (3) securing the cover (4) to the cylinder head. Lift off the cover and discard cover mounting gasket (5).

(4) Loosen rocker arm adjusting screw locknut (7) from each end of the rocker lever shaft. Back off adjusting screws (6) one or two turns.

(5) Remove the nuts (8) and washers (9) from the studs (11). Lift the rocker arm assembly (10) from the studs. Tag the rocker arms for proper installation.

(6) Remove the studs (11) if necessary.





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- |           |                         |
|-----------|-------------------------|
| 1. Nut    | 7. Locknut              |
| 2. Washer | 8. Nut                  |
| 3. Gasket | 9. Washer               |
| 4. Cover  | 10. Rocker arm assembly |
| 5. Gasket | 11. Stud                |
| 6. Screw  | 12. Stud                |

Figure 6-33. Rocker arm assembly, removal and installation.

#### b. Disassembly.

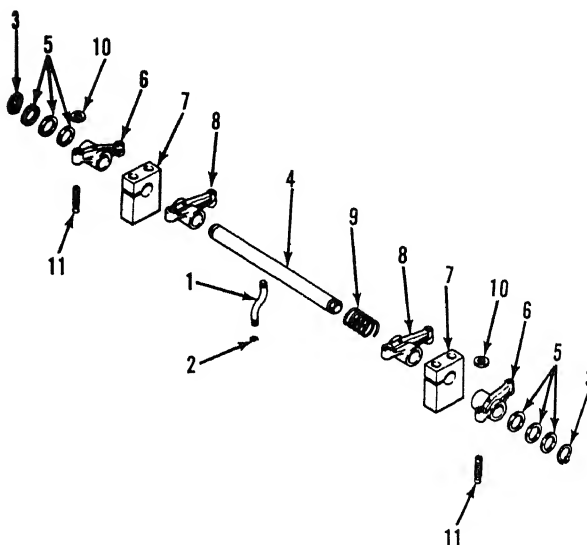
Note. Tag components for proper reassembly. Do not mix parts from one assembly to another.

(1) Remove oil tube (1, fig. 6-34) and discard preformed packing (2).

(2) Remove snap ring (3) from each end of the shaft (4). Remove washers (5), keeping a record of the numbers of washers removed from each end of the shaft.

(3) Remove exhaust rocker arms (6) and bracket (7) from the shaft. Remove intake rocker arms (8) and shaft spring (9).

(4) Remove locknut (10) and adjusting screw (11) from rocker arms.



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- |                      |                     |
|----------------------|---------------------|
| 1. Oil tube          | 7. Bracket          |
| 2. Preformed packing | 8. Rocker arm       |
| 3. Snap ring         | 9. Spring           |
| 4. Shaft             | 10. Locknut         |
| 5. Washers           | 11. Adjusting screw |
| 6. Rocker arm        |                     |

Figure 6-34. Rocker arm assembly, exploded view.

*c. Cleaning, Inspection and Repair.*

- (1) Clean all components with solvent.
- (2) Clean oil passages with compressed air.
- (3) Inspect adjusting screws for flat spots and evidence of scratching or galling. Replace screw if the ball end is not a true sphere.

(4) Check rocker shaft for wear or scoring. If shaft is damaged due to rocker arm action, replace shaft.

(5) Place each rocker arm in position on the shaft. The rocker arm must rest freely on the shaft, without side wobble. If wobble exists, replace rocker arm.

(6) Inspect spring for damage and proper tension. Ten pounds pressure must be required to compress the spring to 1-9/16 inches.

*d. Reassembly. Refer to figure 6-34.*

- (1) Coat components with clean engine oil.
- (2) Install the shaft spring (9) and the two intake rocker arms (8) on shaft (4). Install rocker arms with the shaft oil holes toward the valves.

(3) Install brackets (7) on the shaft with the split side toward the push rod side of the engine.

(4) Install exhaust rocker arms (6) and the same number of washers (5) as were removed during disassembly.

(5) Install snap rings (3) at each end of the shaft. Check rocker arms for free movement.

(6) Install oil tube (1) and new preformed packing (2).

(7) Install adjusting screws (11) and locknuts (10).

*e. Installation.*

(1) Install rocker arm assemblies on the cylinder heads. Ensure that the adjusting screws engage the push rods. Install the studs (11, fig. 6-33), if removed, and install washers (9) and nuts (8). Tighten studs and nuts evenly to a torque of 40 to 45 pound-feet.

(2) Check the clearance at both ends of the rocker arm shafts. Clearance should be between 0.010 and 0.030 inch. Refer to subparagraph *f* for adjustment procedures.

(3) Secure the cover (4) to the cylinder head with a new gasket (5) and six nuts (1), washers (2) and gaskets (3). Tighten nuts to 60 to 70 pound-inches.

(4) Install the crankcase breather (para 4-14).

*f. Adjustment.*

(1) End Clearance. A clearance of 0.010 to 0.030 inch must be maintained at each end of the shaft. Adjust clearance by adding or removing washers between the exhaust rocker arms and the snap rings on the ends of the shaft.

(2) Tappet clearance. Refer to paragraph 6-20.

**6-20. Cylinder Head**

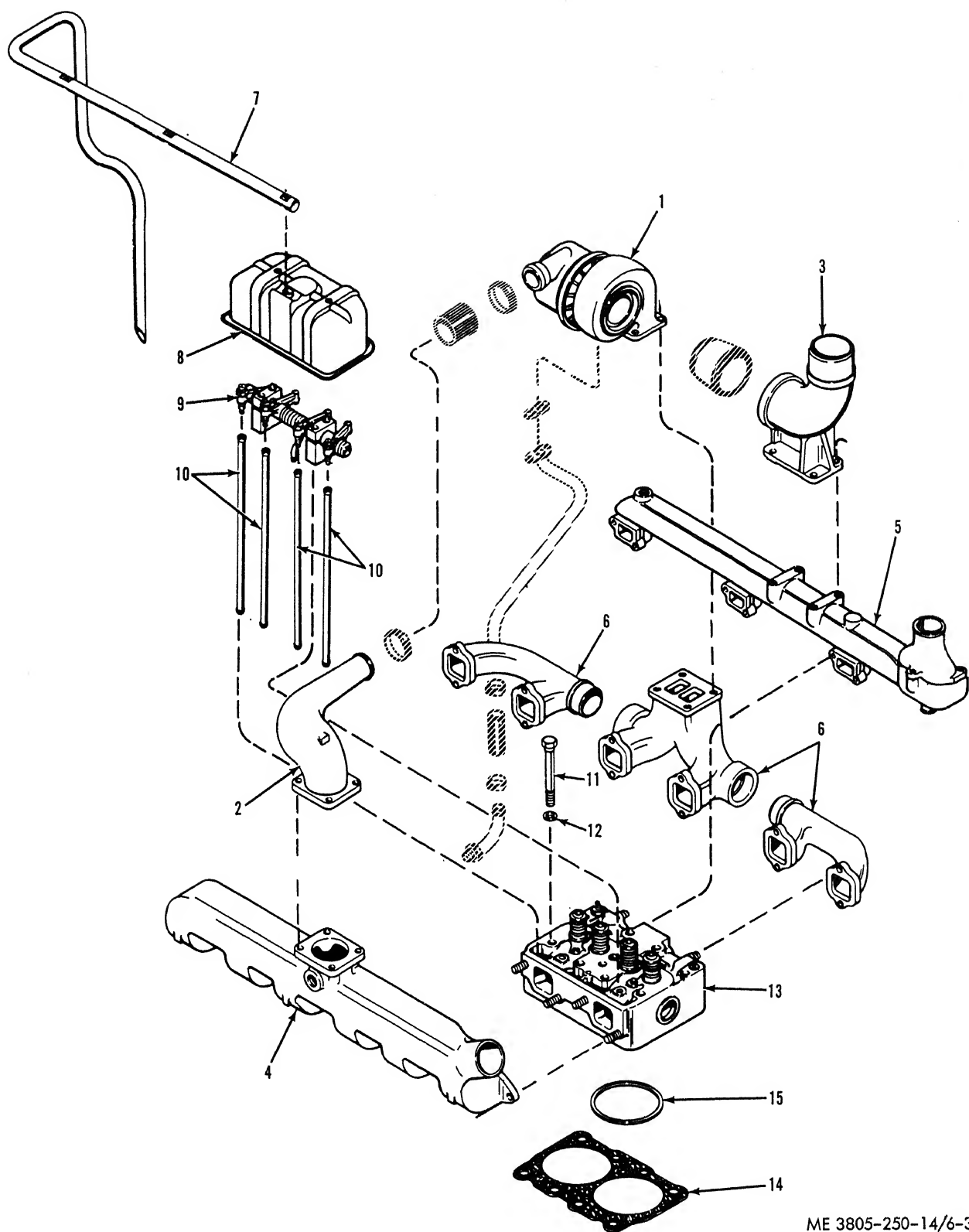
*a. Removal. Refer to figure 6-35.*

(1) Steam-clean the engine.

(2) Drain the cooling system.

(3) Refer to paragraph 6-8 and remove the turbocharger (1).

(4) Remove elbows (2 and 3). Remove the intake manifold (4, para 4-23), water manifold (5) and exhaust manifold (6, para 6-8).



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Figure 6-35. Cylinder head, removal and installation.

KEY to fig. 6-35:

1. Turbocharger
2. Elbow
3. Elbow
4. Intake manifold
5. Water manifold
6. Exhaust manifold
7. Breather tube

(5) Disconnect the high pressure fuel lines and the fuel leak-off tubes between each cylinder head. Cap openings.

(6) Remove the breather tube (7) as instructed in paragraph 4-14. Remove the covers (8) and rocker arm assemblies (9) as instructed in paragraph 6-19.

(7) Remove push rods (10) and tag them for proper installation.

(8) Using torque wrench adapter A42393 (fig. 6-36), remove the cylinder head bolts (11) and washers (12). Remove the cylinder heads (13) from the block. Discard gaskets (14) and fire rings (15)

8. Rocker arm cover
9. Rocker arm assembly
10. Push rod
11. Bolt
12. Washer
13. Cylinder head
14. Gasket
15. Fire ring

b. *Disassembly.* Refer to figure 6-37.

(1) Steam-clean the complete head assembly.

(2) Using a spring compressor, compress spring (1) and remove the valve retainer locks (2). Release the compressor and remove the intake valve spring retainer (3) or the exhaust valve rotator (4).

*Note.* Mark components for installation in the bores from which they are removed.

(3) Remove valve spring (1), valve stem oil seals (5) and valve spring seats (6).

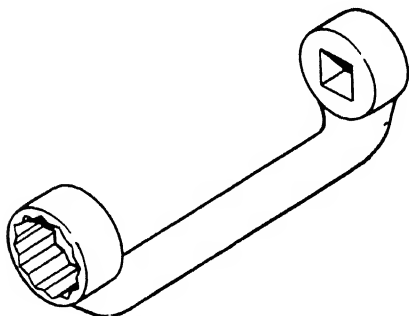
*Note.* Remove any carbon from valve stems before they are removed from the cylinder head.

(4) Remove the intake valves (7) and the exhaust valves (8) from the cylinder head.

(5) Drive the intake valve guide (9) and exhaust valve guide (10) down through the head using an arbor.

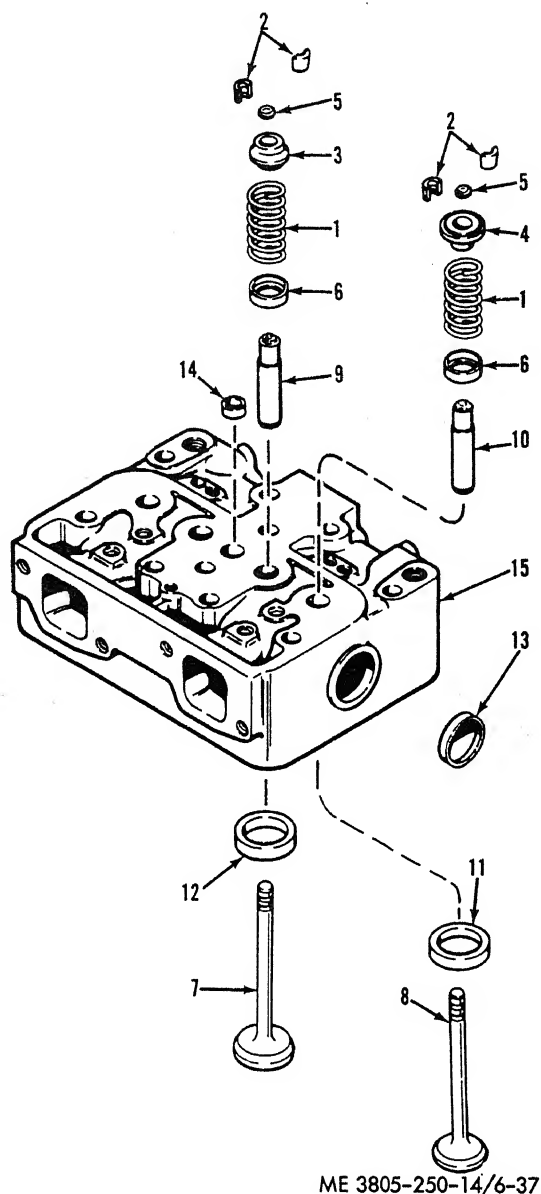
(6) Use a seat removing tool to remove exhaust valve seat (11) and intake valve seat (12).

(7) Remove expansion plugs (13 and 14) from the cylinder head block (15) only if they are to be replaced. Drill hole in plug and pry out.



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Figure 6-36. Cylinder head bolts torque wrench adapter.



1. Spring
2. Retainer locks
3. Spring retainer
4. Rotator
5. Oil seal
6. Valve spring seat
7. Intake valve
8. Exhaust valve
9. Guide
10. Guide
11. Seat
12. Seat
13. Expansion plug
14. Expansion plug
15. Block

Figure 6-37. Cylinder head, exploded view.

### c. Cleaning, Inspection and Repair.

(1) Remove all traces of carbon and other deposits with a clean cloth dampened with solvent.

(2) Inspect and repair the head components as follows:

(a) Inspect the heads for fretting and erosion in the area of fire ring contact and for warping in excess of 0.005 inch. If necessary, resurface the head.

(b) Inspect the push rods for distortion and for cracked or worn ends. Replace if necessary.

(3) Inspect the valve springs for flat or squared ends, and broken coils. Test as follows:

(a) Compress to  $1\frac{31}{64}$  inches at 140 pounds. Replace spring if force required is less than 135 pounds.

(b) Compress to  $1\frac{15}{16}$  inches at 45 pounds. Replace if less than 40 pounds is required.

(4) Inspect and repair valve guides as follows:

(a) Remove all carbon from the bore of the valve guides with a fine wire brush and blow clean with compressed air.

(b) Using a bore gage and micrometer, check the guides at the top, middle, and bottom of the guide bore for wear. If the diameter is greater than 0.4056 inch at any point, replace the guide.

(c) After installing new guides, rebore to 0.4045 to 0.4055 inch diameter.

(5) Inspect and repair the valves as follows:

(a) Clean the valves with a power-driven fine wire brush, being very careful not to scratch the valve stems.

(b) Inspect the valves for excessive wear or nicked stems. Nicks can be caused by a lack of lubrication, plugged water passages, or overloading the engine. Replace valves having nicked stems.

(c) Inspect the valves for deep grooves in the face. Grooves can be caused by abrasives entering the engine through the intake system. If the face cannot be repaired by grinding, replace the valve.

(d) Inspect the valve face for rust or pitting. Remove by grinding the valve face. If the valve stem is rusted or pitted, replace the valve.

(e) Inspect the valve head for dishing and the valve face for deep burned spots. Replace dished or burned valves.

*Note.* Small amounts of very fine pitting may be found on the surfaces of the valve faces and seats. This condition is normal and will not affect engine performance. The valves need not be ground.

### d. Reassembly. Refer to figure 6-37.

(1) If the valve guides have been replaced, install new guides (9 and 10) in the cylinder head (15) using an arbor. Press the guides into the head

from the top of the cylinder head. The guides must protrude 0.953 inch above the cylinder head.

(2) Before installing new exhaust valve seats (11) and intake valve seats (12), clean the recess in the cylinder head. Place the seats in dry ice to shrink them. Insert the seats in the head and drive them into place with a suitable driver.

(3) Lubricate the intake valves (7) and exhaust valves (8) with clean engine oil and install valves in the bores in which they were originally installed.

(4) Install the valve spring seats (6), valve springs (1), and intake valve retainers (3) or exhaust valve rotators (4). Compress the valve springs so that the valve stem seals (5) can be installed in the lower grooves of the valve stems. Install the valve retainer locks (2).

*Note.* If a new exhaust valve is being installed, install a new rotator and retainer locks.

(5) Install new plugs (13 and 14) if they were removed.

*Note.* After the engine is reassembled, a check of rotator operation must be made. Place a dab of white paint on each of the rotators and note its position. Start the engine and observe the rotator. If the rotator turns the valve, it is functioning properly. If it does not turn, replace the rotator.

#### e. Installation.

(1) Measure the cylinder sleeve protrusion as follows to determine the size fire ring to install:

(a) Clean the top surface of the block and sleeve flange using a cloth dampened in solvent.

(b) Using a stone, remove any small burrs in areas to be measured.

(c) Using plate 24918, ball A 28312 and locally-fabricated clamping bar (fig. 5-1), clamp the cylinder sleeve in place as shown in figure 6-38. Tighten capscrews to a torque of 50 pound-feet. Measure sleeve protrusion at points A, B, C and D with either a magnetic base dial indicator or a depth micrometer.

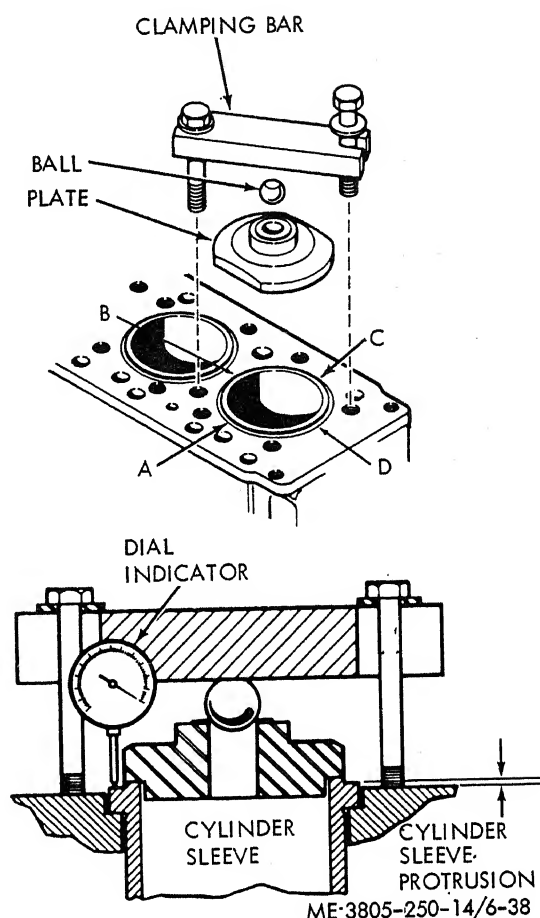


Figure 6-38. Sleeve protrusion measurement.

(d) Choose fire rings according to the following:

1. If both sleeves under one head are flush to 0.002 inch, use oversize fire rings.

2. If both sleeves under one head are 0.002 inch or over with less than 0.0025 inch difference between the sleeves, use standard fire rings.

3. If the difference between the sleeves under one head exceeds 0.0025 inch, use one standard and one oversize fire ring.

*Note.* The oversize fire ring may be identified by a blue marking stripe.

(2) Install new cylinder head gaskets (14, fig. 6-35) on the engine block.

*Note.* Two capscrew holes in the head gasket are slightly smaller and act as guides for positioning the gaskets and fire rings. For difficult installations use dowel A 40953 (fig. 6-39) as a guide.

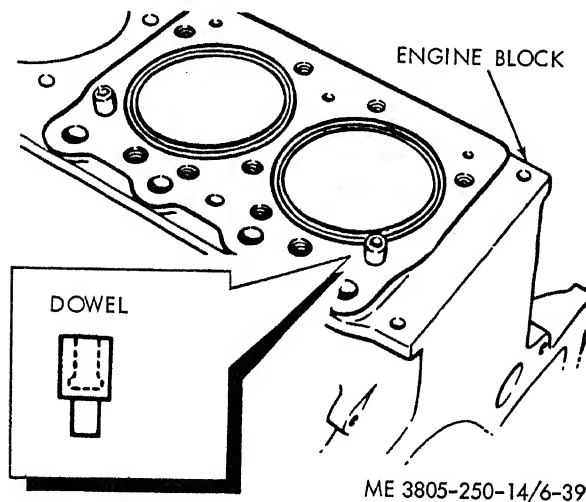


Figure 6-39. Cylinder head installation dowel.

(3) Install new fire rings (15, fig. 6-35) with the lip downward. Fire rings must be dry.

(4) Install the cylinder heads (13) and secure with bolts (11) and washers (12). Remove dowel pins using A40953 tongs (fig. 6-40).

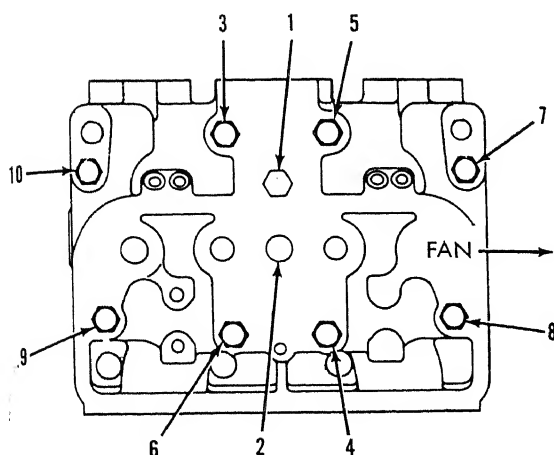


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Figure 6-40. Dowel pin removal tongs.

(5) Using torque wrench adapter A42393 (fig. 6-36) tighten cylinder head bolts in the sequence shown in figure 6-41. The three torque steps are 70, 140 and 190 pound-feet.





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Figure 6-41. Cylinder head bolts torque sequence.

(6) Coat the push rods (10, fig. 6-35) with clean engine oil, and install in the bores in which they were originally installed.

(7) Install the rocker arms (9) as described in paragraph 6-19. Adjust the valve tappet clearance (subpara f).

(8) Install elbows, manifolds and turbocharger. Connect water, fuel and oil lines.

(9) Fill the cooling system and start the engine. Check that the rocker arms are receiving lubricating oil.

(10) Operate the engine for approximately one hour (under load if possible) to thoroughly warm up the engine and seat the head gaskets.

(11) Shut down the engine and retighten the cylinder head bolts to a torque of 210 pound-feet while the engine is still hot. Check and readjust the tappets if required.

(12) Install the valve cover and tighten nuts to a torque of 60 to 70 pound-inches. Do not over-tighten.

(13) Install the breather tube (7) as described in paragraph 3-14.

#### f. Tappet Adjustment.

(1) Remove the rocker arm covers.

(2) Crank the engine until the timing pointer is aligned with the TDC (top dead center) timing mark on the crankshaft pulley (fig. 6-42).

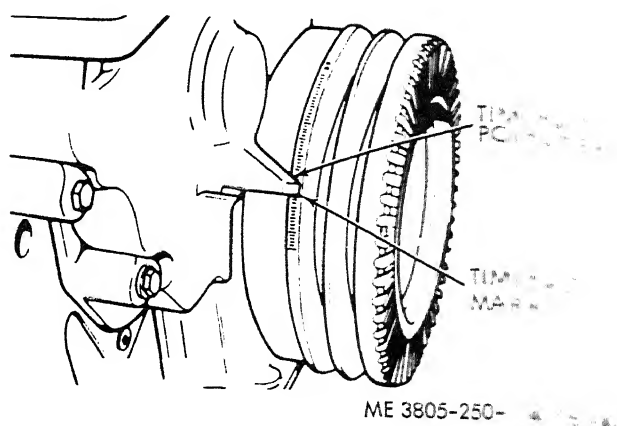
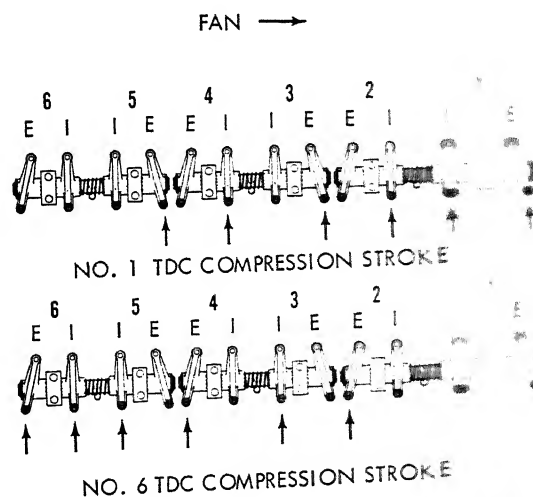


Figure 6-42. Timing mark alignment.

(3) Check the push rods on the No. 1 cylinder for looseness. If the push rods are loose, the No. 1 cylinder is at TDC on the compression stroke. If the push rods are tight, crank the engine one complete revolution and align the points and the mark on the pulley.

(4) Check for intake valve clearance of 0.015 inch on cylinders 1, 2 and 4 and exhaust valve clearance of 0.025 inch on cylinders 1, 3 and 5. Refer to figure 6-43 for TDC compression stroke.



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Figure 6-43. TDC compression stroke.

(5) If necessary, adjust clearance as follows:  
 (a) Loosen the rocker arm locknut and back off the adjusting screw.

(b) Insert a feeler gage between the rocker arm and the top of the valve stem. Tighten the screw until the arm just touches the gage. Tighten the locknut to a torque of 60 to 70 pound-feet.

(6) Crank the engine one complete revolution and align the timing pointer with the TDC mark on the crankshaft damper pulley. Cylinder No. 6 should be at TDC on the compression stroke. Check the No. 6 cylinder push rods for looseness.

(7) Check intake valves for 0.015 inch clearance on cylinders 3, 5 and 6 and exhaust valves for 0.025 inch clearance on cylinders 2, 4 and 6. Refer to figure 6-43. If necessary, adjust clearance as described in step (5).

(8) If the cylinder heads have been removed for servicing and valve adjustments were made after installation, recheck adjustment with the engine at operating temperature. Tappet clearances for hot settings are 0.015 inch for intake valves and 0.020 inch for exhaust valves.

(9) Install the rocker arm covers (para. 6-19).

## 6-21. Piston Assembly

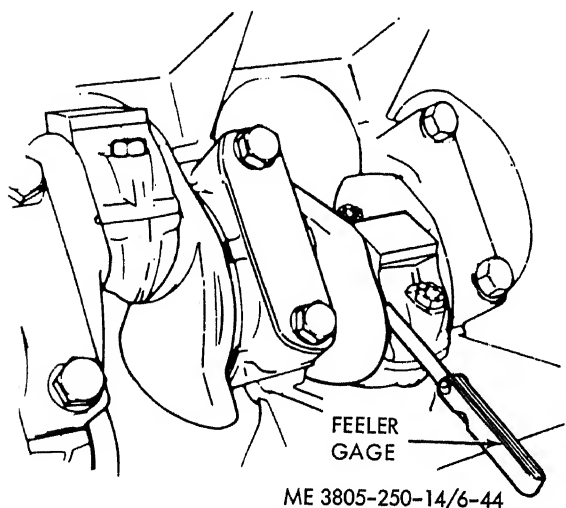
### a. Removal and Disassembly.

**CAUTION:** Before removing pistons, check for a ridge formed in the piston sleeve at the top of the ring travel. If a ridge is present, remove with a ridge reamer to prevent damaging the piston rings and lands.

(1) Remove the cylinder head (para 6-20).

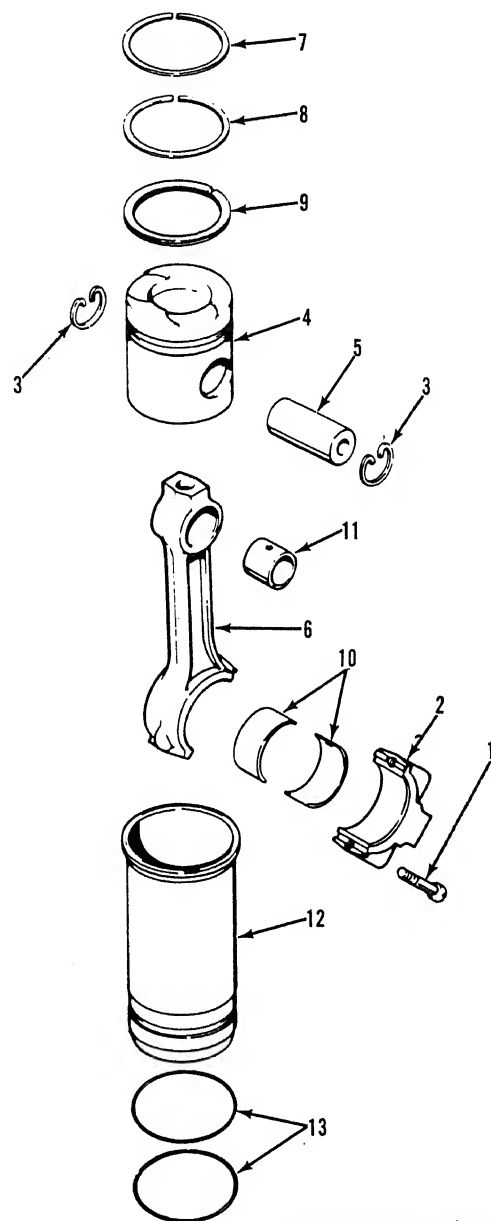
(2) Number the rods and caps for proper installation.

(3) Use a feeler gage and check each connecting rod for excessive side clearance (fig. 6-44). If clearance exceeds 0.012 inch, replace the rods.



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(4) Remove two bolts (1, fig. 6-45) and the connecting rod bearing cap (2), and push the connecting rod and piston assembly up and out through the top of the block.



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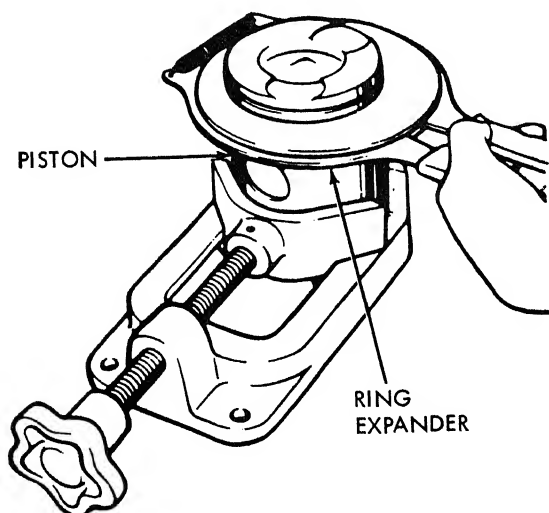
- |                  |                       |
|------------------|-----------------------|
| 1. Bolt          | 8. Piston ring        |
| 2. Cap           | 9. Piston ring        |
| 3. Retainer ring | 10. Liner             |
| 4. Piston        | 11. Bushing           |
| 5. Pin           | 12. Sleeve            |
| 6. Rod           | 13. Preformed packing |
| 7. Piston ring   |                       |

Figure 6-45. Piston assembly, exploded view.

Figure 6-44. Connecting rod side clearance check.

(5) Remove two piston pin retainer rings (3) from each piston (4), and remove the pin (5) from the rod (6) and piston.

(6) Refer to figure 6-46 and use ring expander 5120-393-0549 (616) to remove piston rings (7, 8 and 9, fig. 6-45).



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Figure 6-46. Piston ring expander.

(7) Remove bearing liners (10) from the connecting rod, and cap.

(8) Measure the piston pin bushings (11) inside diameter at three points. If diameter exceeds 1.8018 inches, press the bushings from the rods using an arbor.

**CAUTION:** Cover the crankshaft and main bearings with a cloth before removing the sleeves. Sediment from the block could damage crankshaft and bearings.

(9) If cylinder sleeves (12) are to be removed, mark them for relation with the block. Refer to figure 6-47 and use sleeve puller 5120-417-2952 (970) to remove from the block. Discard preformed packings (13, fig. 7-45).

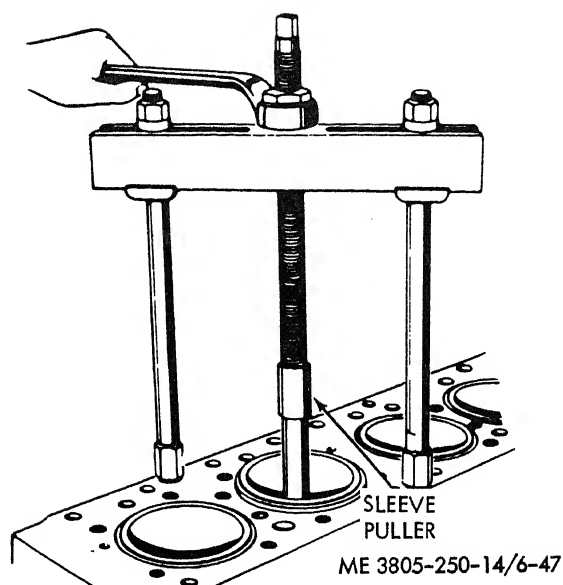


Figure 6-47. Cylinder sleeve puller.

#### b. Cleaning, Inspection and Repair.

(1) Thoroughly clean and inspect all parts for nicks, burrs, scratches, grooves and excessive wear. Replace all parts that are worn or damaged.

(2) Check connecting rods and caps for cracks and any noticeable twist, bowed or bent condition. Replace if damaged.

(3) Remove all carbon deposits from the piston. Be careful not to scratch the piston skirt. Remove all the carbon from the ring grooves with a ring groove cleaning tool.

(4) Inspect the piston pins for cracks, score marks or pitting. Discard piston pins if the polished surfaces are dull, rough or checked by acid corrosion.

(5) Inspect bearing liners for wear, scratches, pitting and metal failure.

(6) Perform the following measurements of the pistons and cylinder sleeves:

*Note.* Measurements should be taken at about 70° F.

(a) Use a micrometer to measure the diameter of the piston across the thrust faces at the bottom of the pistons, perpendicular to the piston pin hole. Replace piston if diameter is 4.620 inches or less.

(b) Use an inside micrometer or cylinder bore gage to check the sleeve bore for out-of-round condition. Check just below the top ring location at its uppermost travel. If sleeve is more than 0.002 inch out-of-round, replace.

(c) Use an inside micrometer or a cylinder bore gage to check the sleeve for wear. If diameter exceeds 4.633 inches at any point, replace.

(d) Use an inside micrometer, cylinder bore gage, or a taper gage to measure the sleeve taper. Check diameter just below the top ring location at its uppermost travel and at several points down the length of the sleeve. Subtract the smallest reading from the largest reading to obtain the amount of taper. Replace the sleeve if taper exceeds 0.007 inch.

*c. Reassembly and Installation.*

(1) Clean the inside surface of the piston pin bushing hole in the connecting rod before installing new bushing.

(2) Install the new bushing (11, fig. 6-45) into the rod (6) while aligning the oil holes in the bushing and rod. Press in the bushing using an arbor.

(3) Carefully ream the bushing to 1.8004 to 1.8008 inches if new piston pins are to be installed. If old piston pins are to be installed, ream the bushings 0.0008 to 0.0014 inch larger than the piston pin diameter.

(4) Install one piston pin retaining ring (3) and heat the pistons to 50°F warmer than piston pin temperature.

(5) Lubricate the piston pin (5) and bushing (11) with engine oil. Assemble the piston (4) to the rod with the recess in the piston top (for the valves) toward the numbered side of the rod.

(6) Install the piston pin by hand and secure with retainer ring (3).

(7) Thoroughly clean the inner surfaces of the cylinder block that contacts the sleeve.

(8) Install sleeve (12) into the block without preformed packings (13) installed to check for free movement. Remove the sleeve, and install preformed packings into the grooves. Lubricate the inside surfaces of the cylinder block and the preformed packings with a thin coating of water soluble grease.

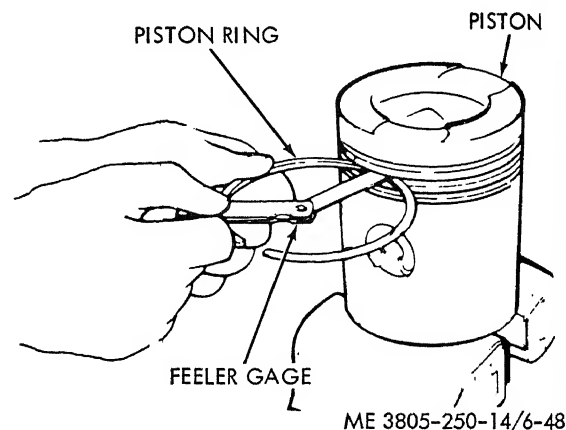
(9) Carefully install the sleeves into the block and press into place by hand. Do not rotate the sleeves during installation.

*Note.* If old sleeves are being installed, they must be installed in the original position. Align marks made during removal.

(10) Install piston rings (9) with the spring up or down.

(11) Check the side clearance of ring (9) as shown in figure 6-48. Side clearance should be

0.0015 to 0.0030 inch. If clearance exceeds 0.0030 inch, replace the piston.



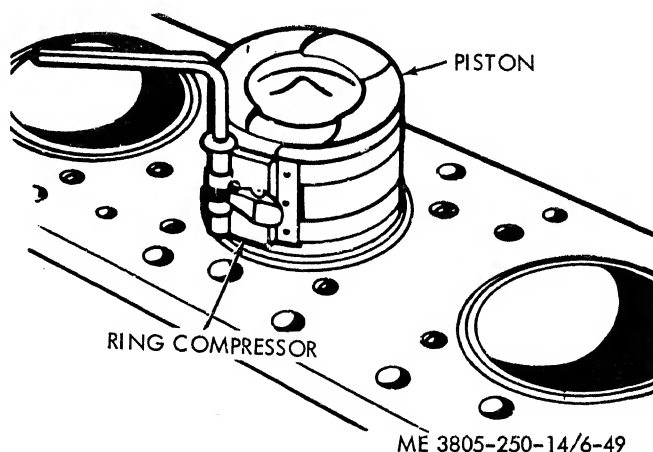
*Figure 6-48. Piston ring side clearance check.*

(12) Install piston ring (8, fig. 6-45) with the "T" or "TOP" side toward the top of the piston. Check side clearance for 0.0035 to 0.0055 inch. If the clearance exceeds 0.0055 inch, replace the piston.

(13) Install piston ring (7) with either side up.

(14) Lubricate the cylinder sleeves and the piston assemblies with engine oil. Rotate the piston rings so that the ring end gaps are staggered.

(15) Refer to figure 6-49 and place ring compressor (849-T) over the piston. Ensure that the piston rings are fully in the grooves, and tighten the compressor a little at a time, ensuring that the rings are free to compress.



*Figure 6-49. Piston ring compressor.*

(16) Clean the crankshaft rod journals. Install bearing liners (10, fig. 6-45) into the connecting rod and cap (2), ensuring that the bearing liner lock lines up with the groove in the rod and cap. Use a sliding movement to install liner; never press on the center of the liner for installation.

(17) Install the piston and rod assembly into its position in the block. With a block of wood and a hammer tap the piston down into the sleeve. Ensure that the connecting rod aligns with the crankshaft journal.

(18) Install the rod cap and liner. Secure with bolts (1) and tighten to 95 to 105 pound-feet.

(19) Check the connecting rod side clearance for 0.005 to 0.012 inch (fig. 6-44).

(20) Install the cylinder head (para 6-20).

## 6-22. Crankshaft

### a. Removal and Disassembly.

(1) Remove the rocker arm cover (para 6-19) and head (para 6-20).

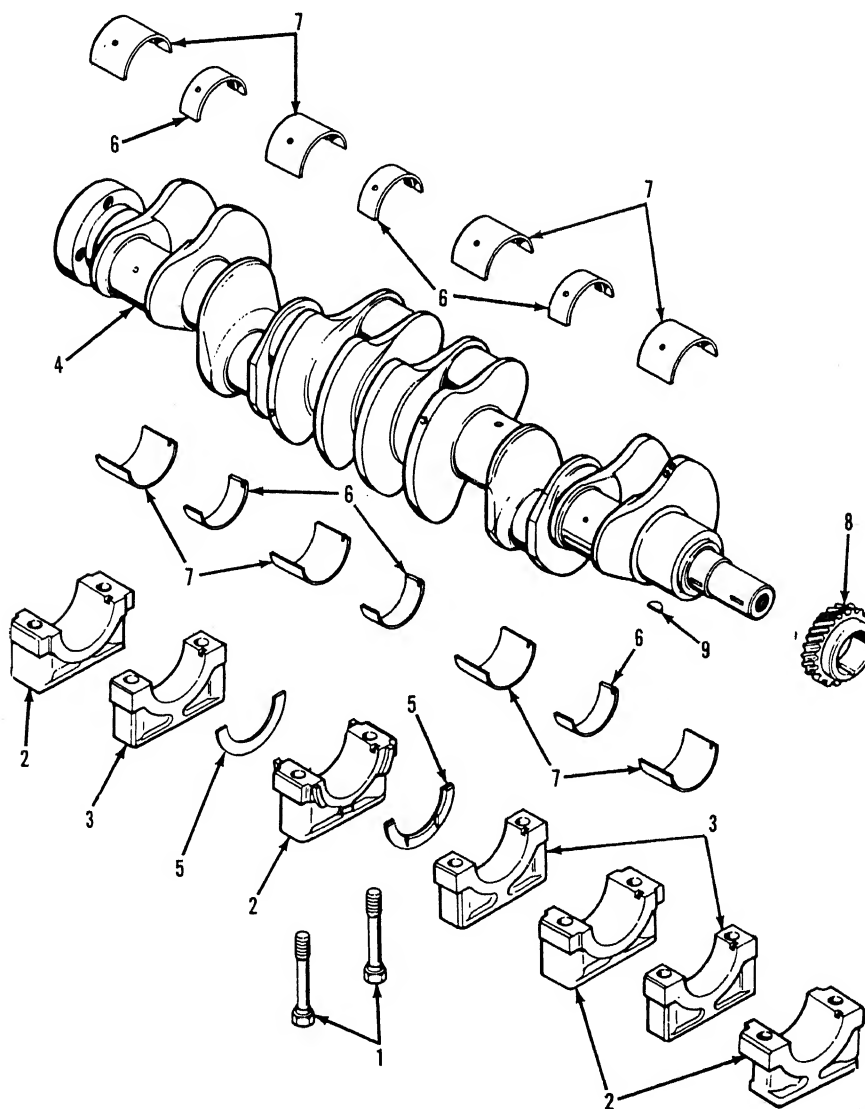
(2) Remove the piston assemblies (para 6-21).

(3) Remove flywheel and housing (para 6-23).

(4) Remove bolts (1, fig. 6-50) and remove four wide bearing caps (2) and three narrow bearing caps (3) from crankshaft (4) and remove the crankshaft from the block.

(5) Remove thrust bearings (5) from the fifth main bearing cap and remove bearing liners (6 and 7).

(6) If crankshaft gear (8) is to be removed, use a gear type puller. Remove key (9).



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Figure 6-50. Crankshaft, exploded view.

*b. Cleaning, Inspection and Repair.*

(1) Thoroughly clean and inspect all parts for nicks, burrs, scratches, grooves and excessive wear. Replace damaged components.

(2) Inspect caps for cracks and deformation. Replace as necessary.

(3) Check the thrust bearings for wear. Replace if thickness is 0.180 inch or less.

(4) Clean the oil holes in the crankshaft and block. Remove pipe plugs at each oil gallery in the block. Coat pipe plug threads with a sealing compound before reinstalling.

(5) Inspect bearing liners for wear, scratches, pitting or metal failure.

(6) Check each main bearing journal with a micrometer for out-of-round condition or excessive wear. If journals are more than 0.001 inch out-of-round or if journal diameters are less than 3.3495 inches, the crankshaft may be worn only 0.002 inch. The 0.002 inch undersize bearing liners can be installed if oil clearance is maintained at 0.0016 inch to 0.0046 inch.

(7) If crankshaft journals are worn more than 0.002 inch, grind the crankshaft journals with precision equipment, checking diameter frequently with a micrometer. Grind the journals undersize 0.010, 0.020 or 0.030 inch.

(8) Clean the crankshaft thoroughly after grinding and check for runout with a dial indicator. If crankshaft runout exceeds 0.002 inch, replace crankshaft.

*c. Reassembly and Installation.*

**CAUTION: The bore in the block and the bearing caps must be absolutely clean. Any dirt left behind the liners will interfere with the cooling of the liners and will result in premature failure.**

(1) Install the upper halves of bearing liners (6 and 7, fig. 6-51) in the block with the lock engaging the lock groove. Lubricate the liners and crankshaft journals with engine oil.

**CAUTION: The main bearings are**

**numbered from 1 through 7 starting with the pulley end of the crankshaft. Make sure the caps are installed in the correct position.**

(2) Carefully set the crankshaft (4) in place in the block and install the bearing caps (3) with new liners (6 and 7) engaging the lock grooves. The numbered side of the main bearing caps must be toward the camshaft.

(3) Install thrust bearings (5) and tighten bearing cap bolts evenly to a torque of 145 to 155 pound-feet.

(4) Check the crankshaft end play as follows:

(a) Insert a pry bar between the crank throw and number 4 or 6 main bearing cap. Take up all end play with the bar.

(b) Check the clearance between the thrust bearings and crankshaft flange with a feeler gage or dial indicator.

(c) Normal crankshaft end play is 0.004 to 0.012 inch. Install 0.006 inch oversize thrust bearing to take up excess end play. If over-size thrust bearing does not correct end play, replace crankshaft.

(5) If the crankshaft gear (8) was removed, install key (9) and press gear onto crankshaft.

(6) Install pistons (para 6-21), rocker arm cover (para 6-19), head (para 6-20), and flywheel and housing (para 6-23).

## **6-23. Flywheel Assembly**

*a. Removal and Disassembly.*

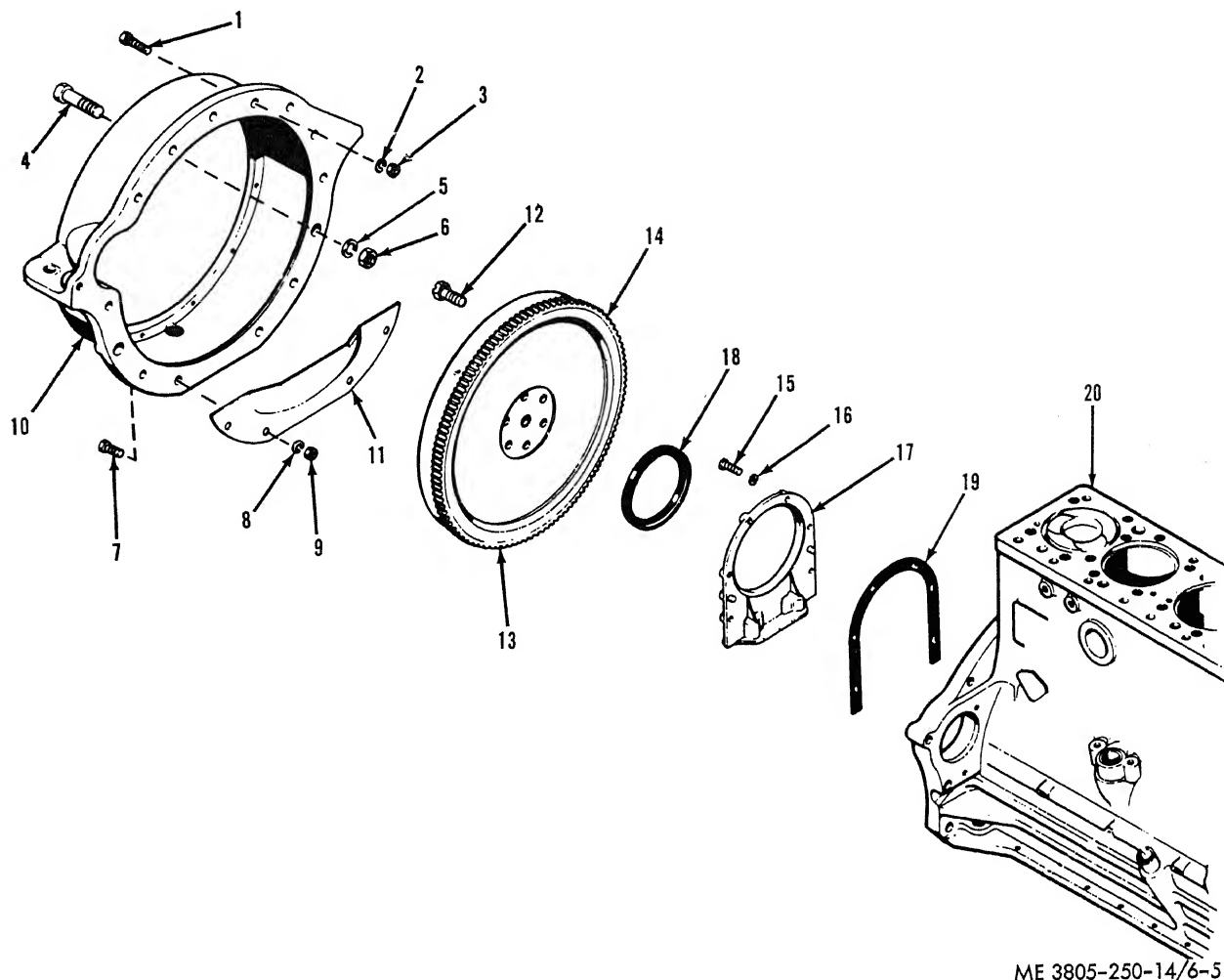
(1) Remove six bolts (1, fig. 6-51), lockwashers (2) and nuts (3). Remove two bolts (4), lockwashers (5) and nuts (6). Remove four bolts (7), lockwashers (8) and nuts (9). Remove flywheel housing (10) and dust shield (11).

(2) Remove six bolts (12), and remove the flywheel (13). If ring gear (14) is worn or damaged, drive it off the flywheel.

(3) Remove six bolts (15) and lockwashers (16), and remove rear oil seal retainer (17). Press out oil seal (18) and discard gasket (19).

**KEY to fig. 6-50:**

1. Bolt
2. Bearing cap
3. Bearing cap
4. Crankshaft
5. Bearings
6. Liner
7. Liner
8. Gear
9. Key



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1. Bolt
2. Lockwasher
3. Nut
4. Bolt
5. Lockwasher
6. Nut
7. Bolt
8. Lockwasher
9. Nut
10. Housing

11. Dust shield
12. Bolt
13. Flywheel
14. Ring gear
15. Bolt
16. Lockwasher
17. Seal retainer
18. Oil seal
19. Gasket
20. Block

Figure 6-51. Flywheel assembly, exploded view.

**b. Cleaning, Inspection and Repair.**

(1) Clean components thoroughly with solvent.

(2) Inspect ring gear for nicked or missing teeth, scoring, distortion or other damage. Replace as necessary.

(3) Discard gaskets and oil seal.

(4) Replace damaged components.

**c. Reassembly and Installation.**

(1) Press new oil seal (18, fig. 6-51) into the retainer (17) with lip inward. Coat the lower part of the seal retainer with sealing compound. Install a new gasket (19) and assemble to block with six bolts (15) and lockwashers (16). Tighten screws to a torque of 35 pound-feet.

(2) If a new flywheel ring gear (14) is to be installed, preheat gear to 400° to 450°F, in either an oven or oil. Assemble ring gear with the large

inside diameter chamfer toward the flywheel.

(3) Install the flywheel (13) and tighten mounting bolts (12) to a torque of 180 to 190 pound-feet.

(4) Install flywheel housing (10) and dust shield (11). Tighten bolts (4) to a torque of 270 to 324 pound-feet. Tighten bolts (1 and 7) to a torque of 80 to 96 pound-feet.

#### **6-24. Timing Gear Assembly**

##### *a. Timing Gear Cover Removal and Disassembly.*

(1) Remove the crankshaft pulley retaining bolt (1, fig. 6-52), lockwasher (2) and washer (3).

(2) Use a puller and remove the crankshaft pulley (4). Remove key (5).

*Note.* Do not pull or hammer the pulley to remove it from the crankshaft.

(3) Remove six bolts (6) and lockwashers (7) securing the damper (8) to the pulley if the damper is to be replaced.

(4) Remove five bolts (9) and lockwashers (10) securing the fuel pump drive gear cover (11) to the housing. Discard gasket (12).

(5) Remove bolts (13) and lockwashers (14) securing the fuel pump drive gear (15) and remove the gear.

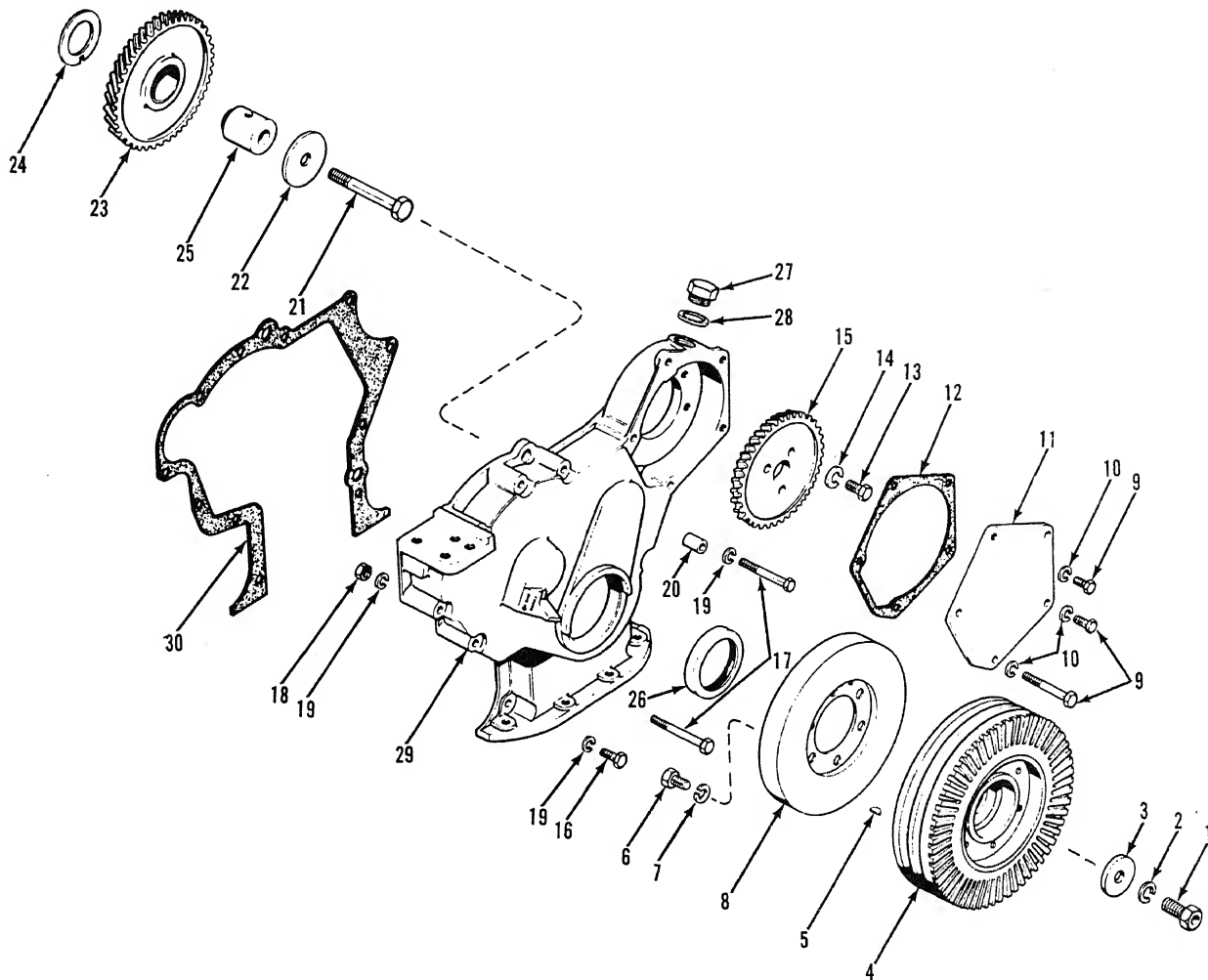
(6) Remove four fuel pump nuts, washers and mounting studs securing the fuel pump to the timing gear cover.

(7) Remove bolts (16 and 17), nuts (18), lockwashers (19) and sleeves (20) securing the timing gear cover to the engine and remove the timing gear cover.

(8) Remove the fuel pump drive, idler gear retainer bolt (21), thrust plate (22), idler gear (23), thrust washer (24) and shaft (25) from the engine block.

(9) Remove the oil seal (26), plug (27) and washer (28) from the timing gear cover (29). Discard gasket (30).





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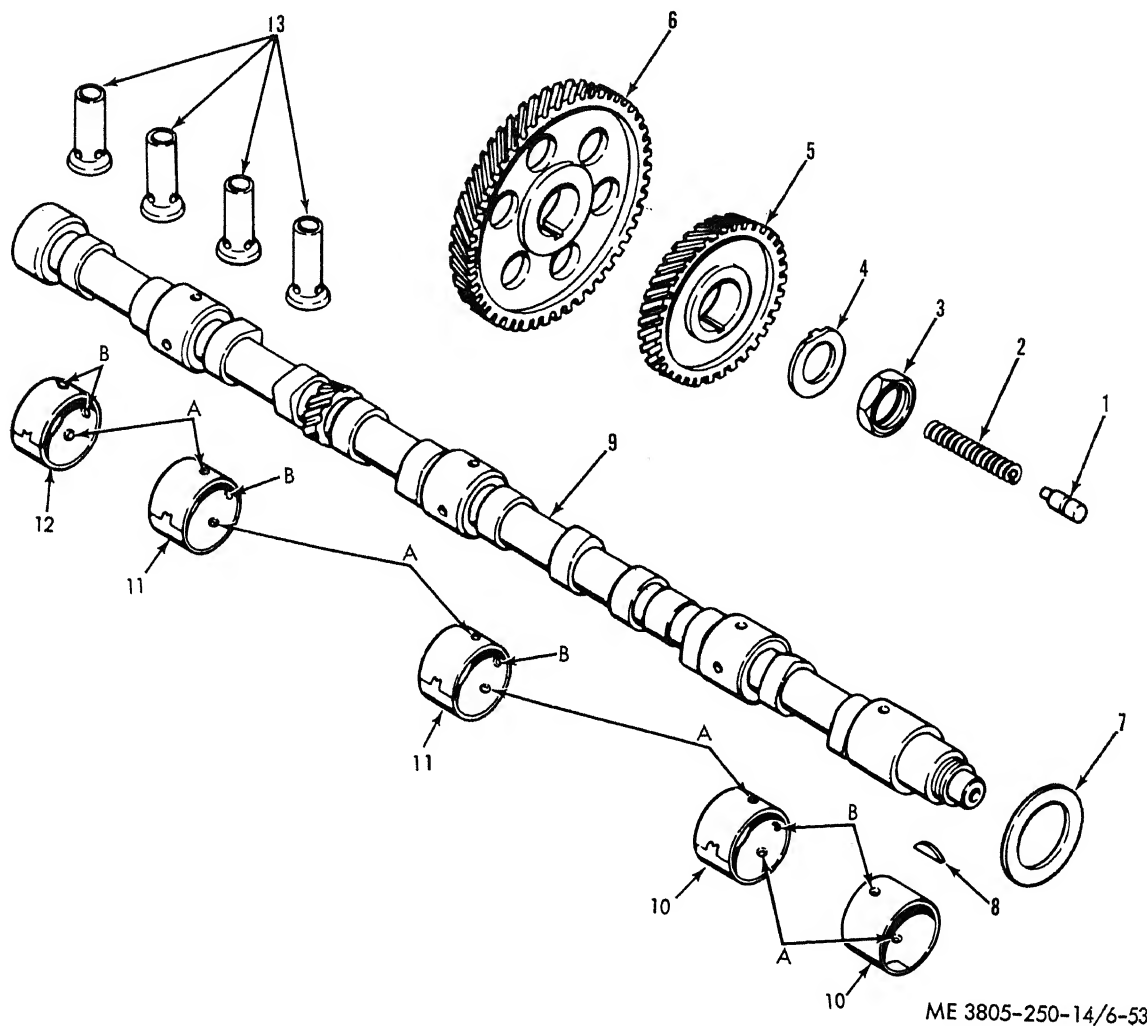
- |                |                  |
|----------------|------------------|
| 1. Bolt        | 16. Bolt         |
| 2. Lockwasher  | 17. Bolt         |
| 3. Washer      | 18. Nut          |
| 4. Pulley      | 19. Lockwasher   |
| 5. Key         | 20. Sleeve       |
| 6. Bolt        | 21. Bolt         |
| 7. Lockwasher  | 22. Thrust plate |
| 8. Damper      | 23. Idler gear   |
| 9. Bolt        | 24. Washer       |
| 10. Lockwasher | 25. Shaft        |
| 11. Cover      | 26. Oil seal     |
| 12. Gasket     | 27. Plug         |
| 13. Bolt       | 28. Washer       |
| 14. Lockwasher | 29. Cover        |
| 15. Drive gear | 30. Gasket       |

Figure 6-52. Timing gear assembly, exploded view.

**b. Camshaft and Timing Gears Removal and Disassembly.**

(1) Remove the thrust plunger (1, fig. 6-53)

and spring (2). Bend up the lip of the camshaft nut lockwasher (4) and remove nut (3) and lockwasher (4).



- |                   |             |
|-------------------|-------------|
| 1. Thrust plunger | 8. Key      |
| 2. Spring         | 9. Shaft    |
| 3. Nut            | 10. Bushing |
| 4. Lockwasher     | 11. Bushing |
| 5. Gear           | 12. Bushing |
| 6. Gear           | 13. Lifter  |
| 7. Washer         |             |

*Figure 6-53. Camshaft and timing gears, exploded view.*

(2) To hold the push rod lifters (13) in a raised position while removing the camshaft, insert wires with a small bend on the end down each push rod hole and into the lifter. Pull upward to raise the lifter and bend the wire over the top of the block.

(3) Pull the camshaft and gear assembly from the engine. Press the camshaft gears (5 and 6) from the shaft. Remove the thrust washer (7) and key (8) from the shaft (9).

(4) Check the camshaft bushings (10, 11 and 12) for wear. If the bushings must be replaced, refer to figure 6-54 and use puller set A41103 to remove the bushings.

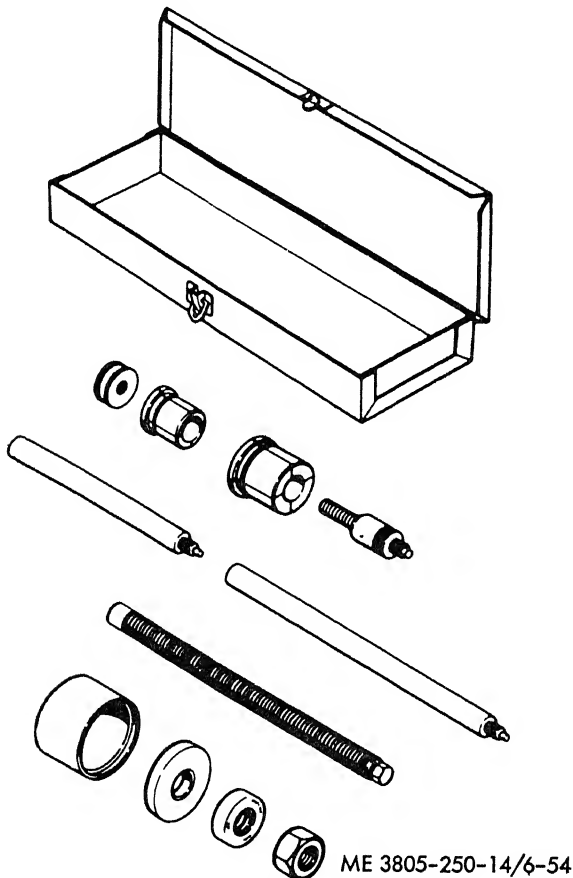


Figure 6-54. Bushing puller set.

(5) Remove the valve lifters (13, fig. 6-53) and mark for proper location.

#### c. Cleaning, Inspection and Repair.

(1) Check the idler gear shaft for wear. Replace shaft if diameter is 1.730 inches or less. Ensure that the running gear clearance between the gear and shaft does not exceed 0.005 inch when assembled.

(2) Inspect gears for nicked, scored, or damaged teeth.

(3) Clean the camshaft thoroughly and blow out the oil holes with compressed air. Check camshaft for roughness, scoring, scratches, grooves or wear. Replace if worn or damaged. Check the camshaft bearing surfaces with a micrometer. If any diameter is less than 2.242 inches, replace the camshaft.

(4) Check the thrust washer thickness. Replace if it is 0.1105 inch or less.

(5) Check the camshaft bushings for wear. If the clearance is 0.007 inch or more between the OD of the camshaft bearing surfaces and the ID of the bushing, replace bushings.

(6) Check the lifter bore in the block for excessive wear or out-of-round condition not to exceed 0.8145 inch diameter at any point. Check bore for scoring or grooves. If necessary, ream the bores to 0.8215 to 0.8225 inch and install 0.010 inch oversize lifters.

(7) Check the thrust plunger spring for damaged coils.

#### d. Camshaft and Timing Gears Reassembly and Installation.

(1) Install new camshaft bushings (10, 11 and 12, fig. 6-53) if they were removed. Install with puller set A41103 as shown in figure 6-54 so that the oil holes are aligned with the holes (A) in the block.

*Note.* The oil holes (B) do not align with the oil holes in the block.

(2) Lubricate the valve lifters (13, fig. 6-53) and install in position in the block. Suspend lifters in the same manner as during removal.

(3) Lubricate the camshaft bushings in the block and install the thrust washer (7), camshaft (9), key (8) and camshaft gears (5 and 6). Align the timing marks on the crankshaft gear and camshaft gear.

(4) Install lockwasher (4) and nut (3). Tighten to a torque of 95 to 105 pound-feet. Bend the lip of the lockwasher over the nut.

(5) Remove the wires securing the lifters.

(6) Install the thrust plunger spring (2) and thrust plunger (1).

(7) Check the backlash between the camshaft gear and crankshaft gear with a dial indicator. If backlash exceeds 0.011 inch, replace gears.

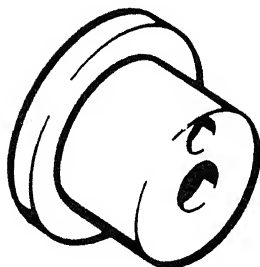
#### e. Timing Gear Cover Reassembly and Installation.

(1) Install the idler gear shaft (25, fig. 6-52), thrust washer (24), idler gear (23), thrust plate (22) and bolt (21). Tighten bolt to a torque of 80 to 96 pound-feet. Check the idler gear for end play. If play exceeds 0.010 inch, replace thrust washer.

(2) Install a new cover gasket (30) and install timing cover (29). Secure with sleeves (20), bolts

(16 and 17), nuts (18) and lockwashers (19). Tighten bolts to a torque of 35 to 42 pound-feet.

(3) Coat oil seal (26) with a sealing compound and lubricate the inner surface with engine oil. Install the seal in the cover using A60533 seal installation tool (fig. 6-55). Place the lip in and the "TOP" mark up so that the seal is flush with the outer edge of the cover.



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Figure 6-55. Seal installation tool.

(4) Secure the fuel pump to the timing gear cover with four nuts, washers and mounting studs. Refer to paragraph 6-2.

(5) Install the fuel pump drive gear (15) with bolts (13) and lockwashers (14). Tighten bolts to a torque of 35 to 42 pound-feet. Check the pump drive gear backlash using a dial indicator.

(6) Install new gasket (12) and cover (11) with bolts (9) and lockwashers (10). Tighten bolts to a torque of 17 to 20 pound-feet.

(7) Assemble the damper (8) to the pulley (4) aligning locating pin. Tighten bolts to a torque of 35 to 42 pound-feet.

(8) Install key (5) in the slot in the crankshaft and install the crankshaft pulley assembly on the crankshaft. Retain with washer (3), lockwasher (2) and bolt (1). Tighten bolt to a torque of 100 to 110 pound-feet.

(9) Install plug (22) and washer (23).

(10) Check the backlash between the following gears:

Crankshaft to camshaft .....	0.004 to 0.011 inch
Idler drive to idler gear .....	0.003 to 0.010 inch
Idler gear to fuel pump gear .....	0.004 to 0.012 inch

If backlash exceeds these specifications, replace gears. Check for worn camshaft bushings.

## 6-25. Engine Block

### a. Disassembly.

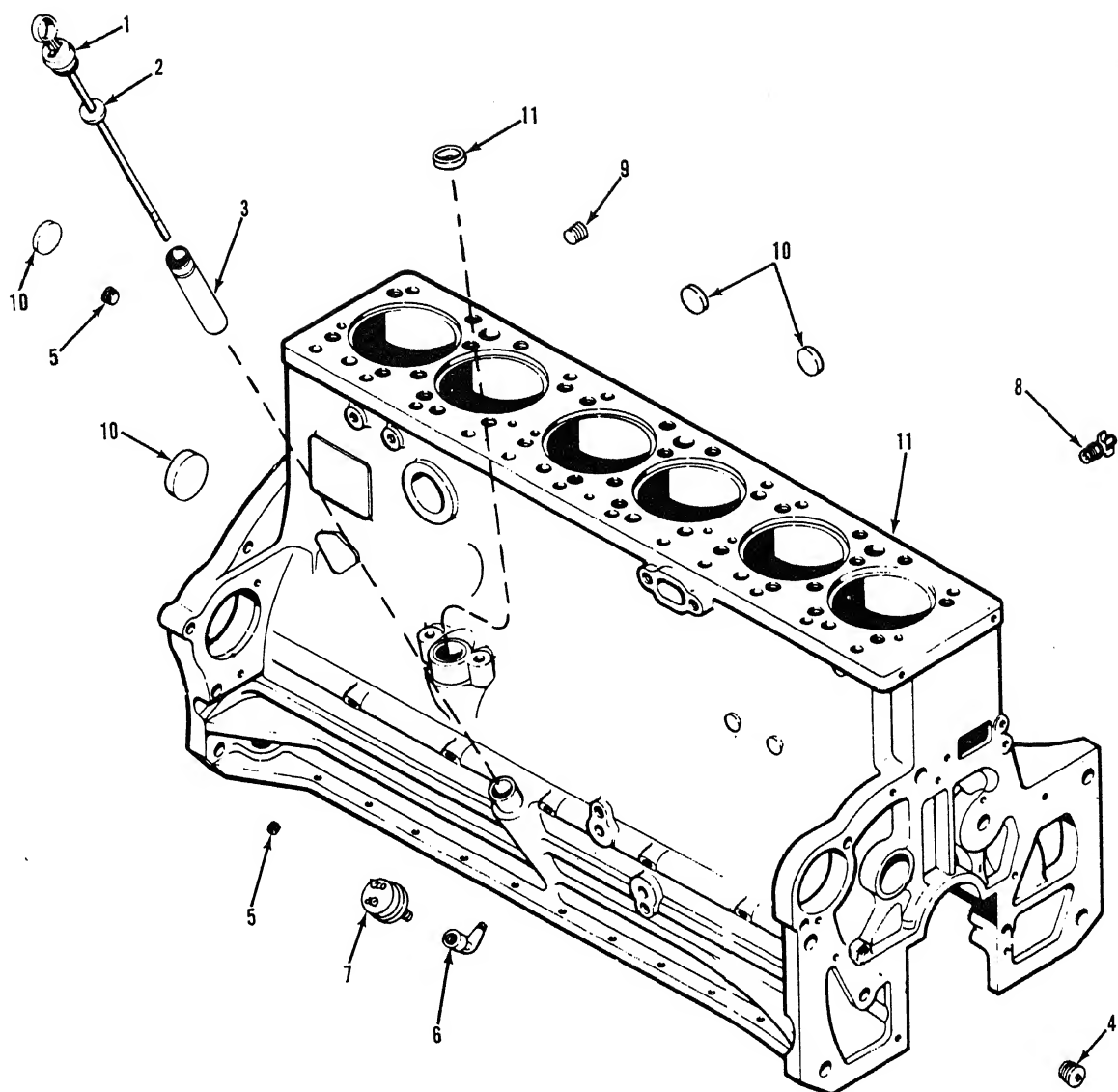
(1) Remove rocker arm (para 6-19), cylinder head (para 6-20), pistons (para 6-21), flywheel and housing (para 6-23), crankshaft (para 6-22), timing gear assembly (para 6-24), oil pan (para 6-11), and engine oil pump (para 6-12).

(2) Remove the dipstick (1, fig. 6-56), preformed packing (2) and tube (3).

(3) Remove oil plugs (4 and 5).

(4) Remove oil pressure sending unit and elbow (6) and two oil pressure switches (7).

(5) Remove drain cock (8), plug (9), cup plugs (10) and plug (11).



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1. Dipstick
2. Preformed packing
3. Tube
4. Oil plug
5. Oil plug
6. Elbow

7. Oil pressure switch
8. Drain cock
9. Plug
10. Cup plug
11. Plug

Figure 6-56. Block, exploded view.

**b. Cleaning, Inspection and Repair.**

- (1) Clean all parts with solvent.
- (2) Remove all corrosion and scale from the water jackets and passages with high pressure water and steam.
- (3) Clean all oil passages with high pressure steam and solvent. Flush with water and dry with compressed air.
- (4) Clean out all recesses and threaded or drilled holes.
- (5) Inspect for thread damage.
- (6) Inspect the block thoroughly for cracks, wear, signs of strain and other damage. Replace block if damage cannot be repaired by welding or minor machining.
- (7) Inspect gasket surfaces for warpage, nicks

or burrs. Smooth by grinding. Replace block if excessively warped.

c. *Reassembly.* Assemble the block by reversing the disassembly procedure. Coat the outer edge of

cup plugs with a plastic lead sealant. Install the cup plugs until the outer edge is even with the chamfer in the bore of the block.

## CHAPTER 7

# REPAIR OF TRANSMISSION AND DRIVE COMPONENTS

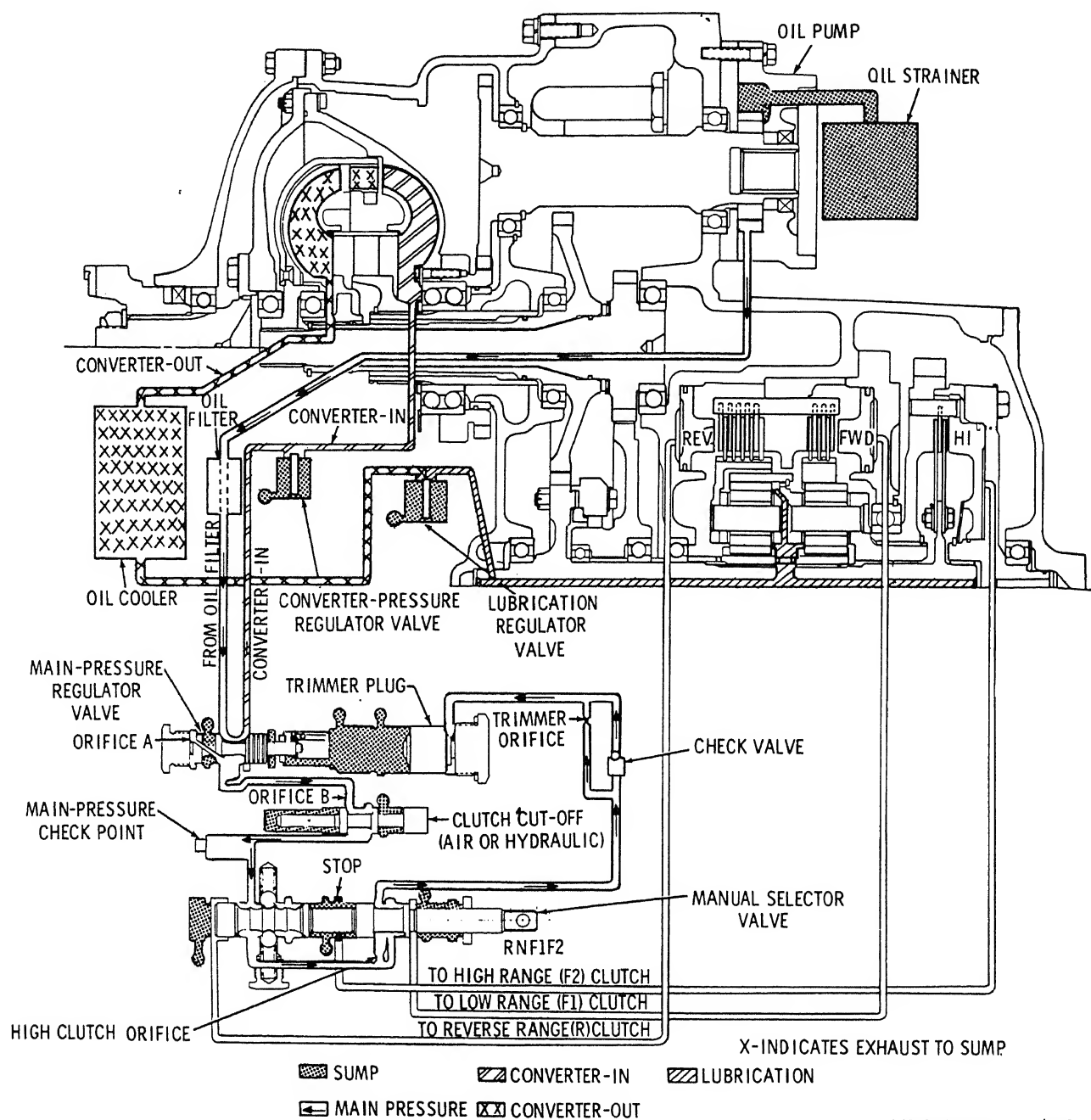
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### Section I. TRANSMISSION

#### 7-1. General

The hydraulic transmission consists of the dual turbine torque converter, the range transmission, a hydraulic oil charging pump, an oil filter, an oil cooler, a selector valve, and the interconnecting hydraulic lines. The torque converter is bolted to the engine flywheel housing, and is driven by a ring gear attached to the flywheel. The range transmission is bolted to the rear frame, and provides the rear mounting for the engine. The range transmission case houses the transmission clutches

and transfer gears, provides the hydraulic sump for the transmission system, and provides mounting for the equipment hydraulic pump, charging pump, and range selector valve. The transmission oil filter is attached to a bracket mounted at the rear of the engine. The transmission oil cooler is an integral part of the engine radiator. Refer to figure 7-1 for oil flow through the transmission system. Power flow is from the engine to the torque converter, through the range transmission to the transfer gears, then to the propeller shafts, differentials, and final drives.



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Figure 7-1. Transmission and torque converter hydraulic schematic diagram.

## 7-2. Torque Converter

### a. Removal.

- (1) Remove the engine and transmission from the loader as a unit. Refer to paragraph 5-7.
- (2) Position the transmission so it is resting on its rear surface. Support the transmission with

wooden blocking to prevent damage to the rear drive flange.

*Note.* The torque converter is not removed from the transmission as a unit. Removal of the internal torque converter parts is accomplished with the torque converter housing attached to the transmission case.

### b. Disassembly. Refer to figure 7-2.



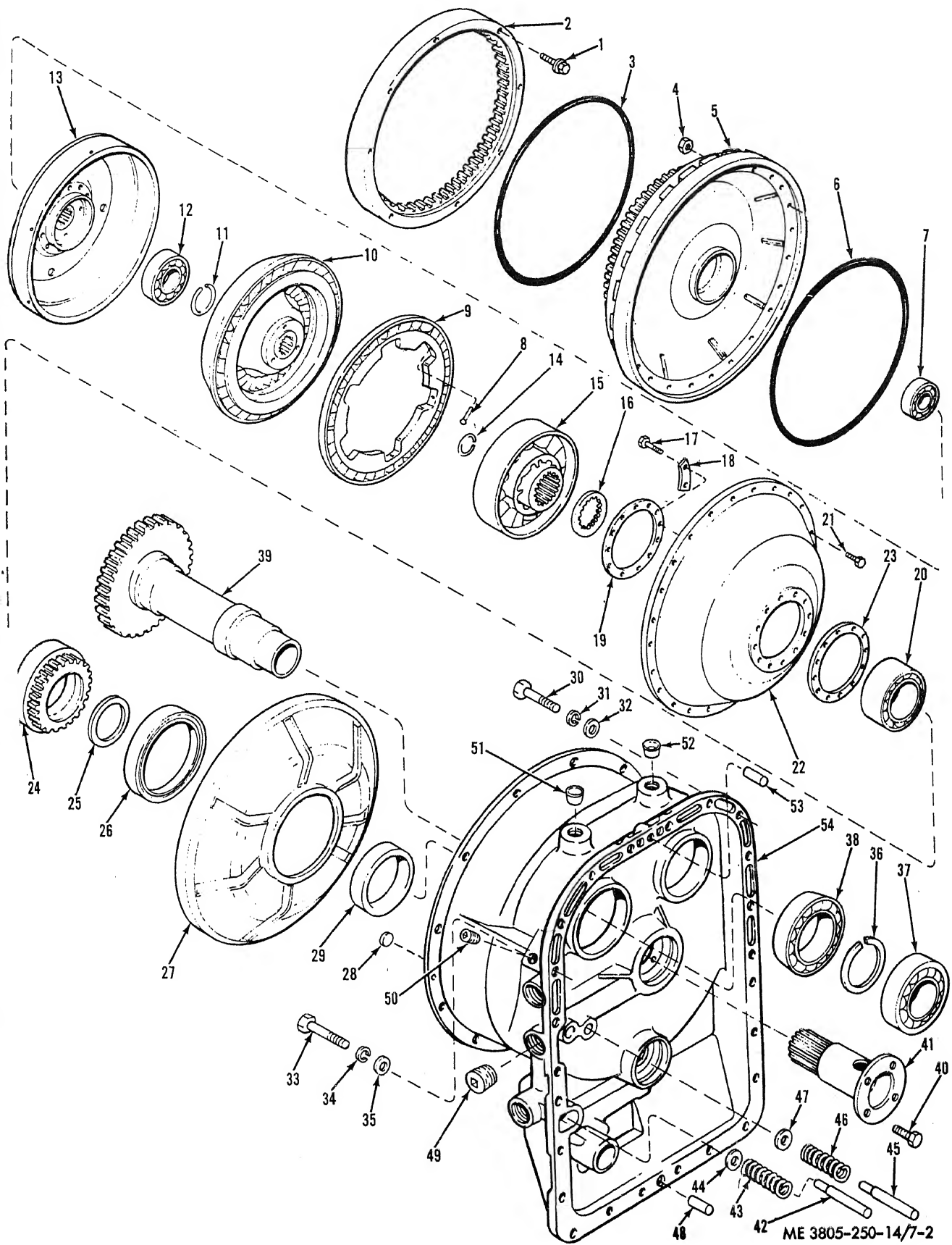


Figure 7-2. Torque converter, exploded view.

KEY to fig. 7-2:

1. Bolt
2. Ring gear
3. Seal
4. Nut
5. Cover
6. Seal
7. Bearing
8. Roll pin
9. First turbine
10. Second turbine
11. Retaining ring
12. Bearing
13. Turbine support
14. Retaining ring
15. Stator
16. Spacer
17. Bolt
18. Locking plate
19. Retainer
20. Bearing
21. Bolt
22. Pump
23. Gasket
24. Accessory drive gear
25. Seal
26. Diaphragm seal

27. Diaphragm
28. Plug
29. Sleeve
30. Bolt
31. Lockwasher
32. Flat washer
33. Bolt
34. Lockwasher
35. Flat washer
36. Retaining ring
37. Bearing
38. Bearing
39. Drive gear
40. Bolt
41. Sleeve
42. Pin
43. Spring
44. Valve
45. Pin
46. Spring
47. Valve
48. Dowel pin
49. Plug
50. Plug
51. Plug
52. Plug
53. Dowel pin
54. Housing

(1) If necessary, remove bolts (1) securing the converter ring gear (2) to the engine flywheel.

(2) Remove and discard seal (3).

(3) Remove the twenty-four nuts (4) securing the converter front cover (5) to the converter pump (22).

(4) Remove seal (6) and bearing (7) from the cover (5) or turbine support (13).

(5) Insert two screwdrivers in the openings in the turbine assembly and, lifting straight up, remove the turbine assembly as a unit.

(6) Locate the match marks on the outer rims of the turbine support (13) and first turbine (9). The marks should be well defined on both parts. If not, deepen the marks to a maximum depth of 0.040 inch before continuing disassembly.

(7) Drive the six roll pins (8) toward the hub of the second turbine (10) until they clear the first turbine support (13). Remove the pins only if replacement is needed.

(8) Remove the first turbine (9), second turbine (10) and bearing (12) from the turbine support (13). Press the bearing (12) from the second turbine (10) by inserting three equal length pieces of drill rod in the holes of the turbine hub and pressing against the rods. Remove retaining ring (11).

(9) Remove retaining ring (14) and remove the stator (15) and spacer (16) from the ground sleeve (41).

(10) Straighten the tabs on locking plate (18) and remove four equally spaced bolts (17) from the pump hub. Fabricate the special puller (fig. 5-12) and install as shown in figure 7-3, making sure the puller sleeve rests on the ground sleeve and extends above the end of the first turbine drive gear. Tighten the puller screw until the bearing (20) has been drawn from its seat on the ground sleeve, then remove the puller.

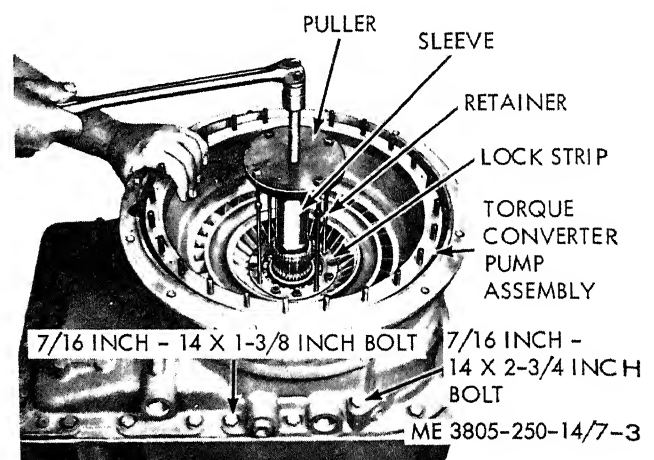


Figure 7-3. Loosening torque converter pump bearing.

(11) Remove the remaining eight bolts (17) from the pump hub, and separate pump retainer (19), bearing (20), gasket (23), and accessory drive gear (24), from the pump housing (22). Press the special bolts (21) from the pump housing only if replacement is required.

(12) Slit the diaphragm (27) horizontally at a point  $\frac{1}{2}$  inch from the edge to a point  $\frac{1}{2}$  inch from the inner edge of the bore. Insert a hooked tool in the slit and pry the metal above the slit outward. This will deform the diaphragm sufficiently to permit its removal.

(13) Remove the seal (25) from the ground sleeve (41). Remove the diaphragm seal (26), diaphragm (27), plug (28), and housing sleeve (29) from the housing.

(14) Remove the twenty-three bolts (30), and one bolt (33), lockwashers (31 and 34), and flat washers (32 and 35) securing the torque converter housing (54) to the transmission case.

**CAUTION: If the freewheel unit is raised with the converter housing, the oil suction tube may be damaged. If the second turbine drive gear is raised with the housing, it may fall unexpectedly causing damage or injury.**

(16) Remove the retaining ring (36) and bearing (37) from the drive gear (39). Tap the drive gear forward and remove it from the housing. Pull bearing (38) from the drive gear only if it is to be replaced.

(17) Remove the four bolts (40) which secure the converter ground sleeve (41) to the housing (54), and press the sleeve from the housing.

(18) Twist the converter pressure regulator pin (42) to remove it from the housing, and remove spring (43) and valve (44).

(19) Remove lubrication regulator pin (45), spring (46), and valve (47) in the same manner as the converter pressure regulator.

(20) Remove plugs (49, 50, 51 and 52) and dowel pins (48 and 53) from the housing only if replacement is necessary.

#### *c. Cleaning, Inspection and Repair.*

(1) Clean all parts with solvent and dry the parts with compressed air or clean, lint-free cloths. Flush bearings thoroughly to remove packed deposits in the races. After cleaning, allow the bearings to air dry. Do not spin bearings or use compressed air to dry them, as damage due to lack of lubrication may occur.

(2) Inspect all parts for cracks, fatigue lines, nicks, scratches, burrs, wear, and other visible damage. Inspect gear teeth for chipping, broken teeth and wear. Check bearings for wear, nicks,

scratches, pitting and other damage to the bearings and races.

(3) Remove burrs, scratches and light scoring from machined surfaces with a soft honing stone or crocus cloth. Replace any damaged or badly worn parts. Replace worn or damaged bearings. Replace all gaskets and seals.

*d. Reassembly.* Refer to figure 7-2.

(1) Install dowel pins (48 and 53), if removed. Press pins in housing (54) until they project  $0.440 \pm 0.010$  inch above the housing surface.

(2) Install plugs (28, 49, 50, 51 and 52) if they were removed. Press plugs (51 and 52) into the housing until they are a minimum of 0.03 inch below the surface. Drive plug (28) flat side first into its bore until it seats against the shoulder in the bore.

(3) Assemble lubrication regulator valve (44) and spring (43) to pin (42). Press the pin into the housing until it is flush to 0.010 inch below the housing surface.

(4) Assemble the pressure regulator valve (47), and spring (46) to pin (45). Press the pin into the housing until it projects  $1.19 \pm 0.01$  inch above the valve seat.

*Note.* If the press fit of pins (42 and 45) is not satisfactory, apply a sealant to the pins and their respective bores and install them as described. Allow the sealant to dry two hours at room temperature.

(5) Chill the converter ground sleeve (41) in dry ice for at least one hour. Align the bolt holes in the sleeve with those in the housing, and press the sleeve into the housing. Install bolts (40) and tighten to 17 to 20 pound-feet.

(6) Install bearing (38) on drive gear (39) with the retaining ring groove away from the gear.

(7) Press bearing (37) on the drive gear. Install the gear and bearing assembly onto the front of the housing and secure it with retaining ring (36).

(8) Heat converter housing sleeve (29) and press it onto the housing hub, seal ring groove side last. Install a new seal ring (25). Use oil-soluble grease to retain the seal.

(9) Coat the outer rim of the diaphragm assembly (27) with nonhardening sealer, and start it, convex side first into the housing. The arrow on the diaphragm must point toward the bottom of the housing. Use a wood block contoured to the surface of the diaphragm and a soft hammer to drive the diaphragm into position. Move the block evenly around the diaphragm circumference, driving slightly at each position.

(10) Install a new gasket on the torque converter housing, retaining the gasket with oil-soluble grease.

(11) Attach a sling to the converter housing, and carefully lower the housing onto the transmission case. Guide the drive gear past the second turbine drive gear, and seat the housing on the transmission case.

(12) Remove the sling and install twenty-three bolts (30), one bolt (33), twenty-four lockwashers (31 and 34) and twenty-four flat washers (32 and 35). Tighten the bolts to  $46 \pm 4$  pound-feet.

(13) Check the seal ring on the housing hub to make sure it is firmly seated. Check the diaphragm seal to make sure it is packed with high temperature grease. Pack seal if necessary.

(14) Press pump special bolts (21) into the pump flange, flat side towards the pump.

(15) Install bearing (20) in the accessory drive gear (24) with loading notch toward the pump side of the gear.

(16) Place a new gasket (23) on the accessory drive gear, and position the converter pump assembly (22) on the gear. Install the pump retainer (19), locking plates (18) and bolts (17). Tighten the bolts to  $11 \pm 1$  pound-feet and bend lock plates up to secure the bolts.

(17) Install the assembled torque converter pump onto the converter ground sleeve. Install the stator spacer (16) and stator (15) hub projection first on the ground sleeve, and secure with retaining ring (14). Install seal (6) on the pump.

(18) Press bearing (12) into the second turbine (10), with identification number facing away from the turbine. Install retaining ring (11).

(19) Press bearing (7) onto the turbine support (13), with identification number facing away from the support.

(20) Install the second turbine (10) and first turbine (9) in the turbine support (13). Align the match marks on the first turbine and support. Drive the roll pins (8) outward, until they are flush to 0.030 inch below the outer surface of the turbine support.

(21) Install the converter cover (5) and secure with nuts (4). Tighten the nuts to  $16 \pm 2$  pound-feet.

(22) Install new seal (3) on the converter cover. Make sure the ring enters the groove behind the spline on the cover.

(23) If removed, install converter ring gear (2) on the engine flywheel with bolts (1). Tighten the bolts to 36 to 43 pound-feet, and pack the drive ring counterbore with bearing grease.

*Note.* Grease must not attack the Buna or Polyacrylate rubber compounds.

#### *e. Installation.*

(1) Attach a hoist to the eyebolts in the top of the transmission, and raise the transmission and

torque converter into an upright position.

(2) Position the torque converter and transmission on the engine, and secure with twelve capscrews and lockwashers.

(3) Install the engine and transmission unit in the loader as described in paragraph 5-7.

### **7-3. Transmission**

#### *a. Removal.*

(1) Remove the engine and transmission from the loader as a unit. Refer to paragraph 5-7 for removal procedures.

(2) Disassemble and remove the torque converter as described in paragraph 7-2.

#### *b. Disassembly.* Refer to figure 7-4.

*Note.* Refer to sheet 3 of the illustration for steps 1 through 3.

(1) Remove the drain plug (1) and drain transmission oil.

(2) With the transmission resting on its rear surface, remove bolts (2 and 3) and lockwashers (4) securing the control valve (5) to the housing. Remove gasket (6). Reinstall bolt (3) and one lockwasher (4) to retain clutch anchor pin.

(3) Remove bolts (7 and 8) and lockwashers (9 and 10), and remove the charging pump assembly (11) and gasket (12).

*Note.* Refer to sheet 1 of the illustration for steps 4 through 12.

(4) Remove the second turbine drive gear (13), seal (14) and bearing (15) as a unit. Remove the seal and bearing from the second turbine gear. If thrust bearing race (16) remained on the hub of the second turbine gear, remove it from the gear.

(5) Remove the first turbine driven gear (17), second turbine driven gear (18) and the freewheel clutch assembly (26 through 31) as a unit.

(6) Press the second turbine driven gear (18) from the assembled unit. This will free spacers (19 and 20), bearing (21) and the freewheel clutch rollers (22).

(7) Press bearing (23) from first turbine driven gear (17).

(8) Remove twelve nuts (24) securing the freewheel clutch unit to the second turbine driven gear (18). Pry the cam (25) away from the gear, and remove the spring plate (26), springs (27), spring guide pins (28), roller cage (29), cam (25), bolts (30), retainer plate (31), and pins (32).

(9) Pull bearings (33 and 34) from second turbine driven gear (18).

(10) Remove seal (35) thrust bearing races (16 and 36), and thrust bearing (37) from the first turbine drive gear (38). Remove drive gear and bearing (39) and separate by heating the inner race of bearing to 450°F and pressing the drive gear from bearing.

(11) Remove the oil suction tube (43) by loosening compression nut (40) and seat (41) and removing capscrew (42).

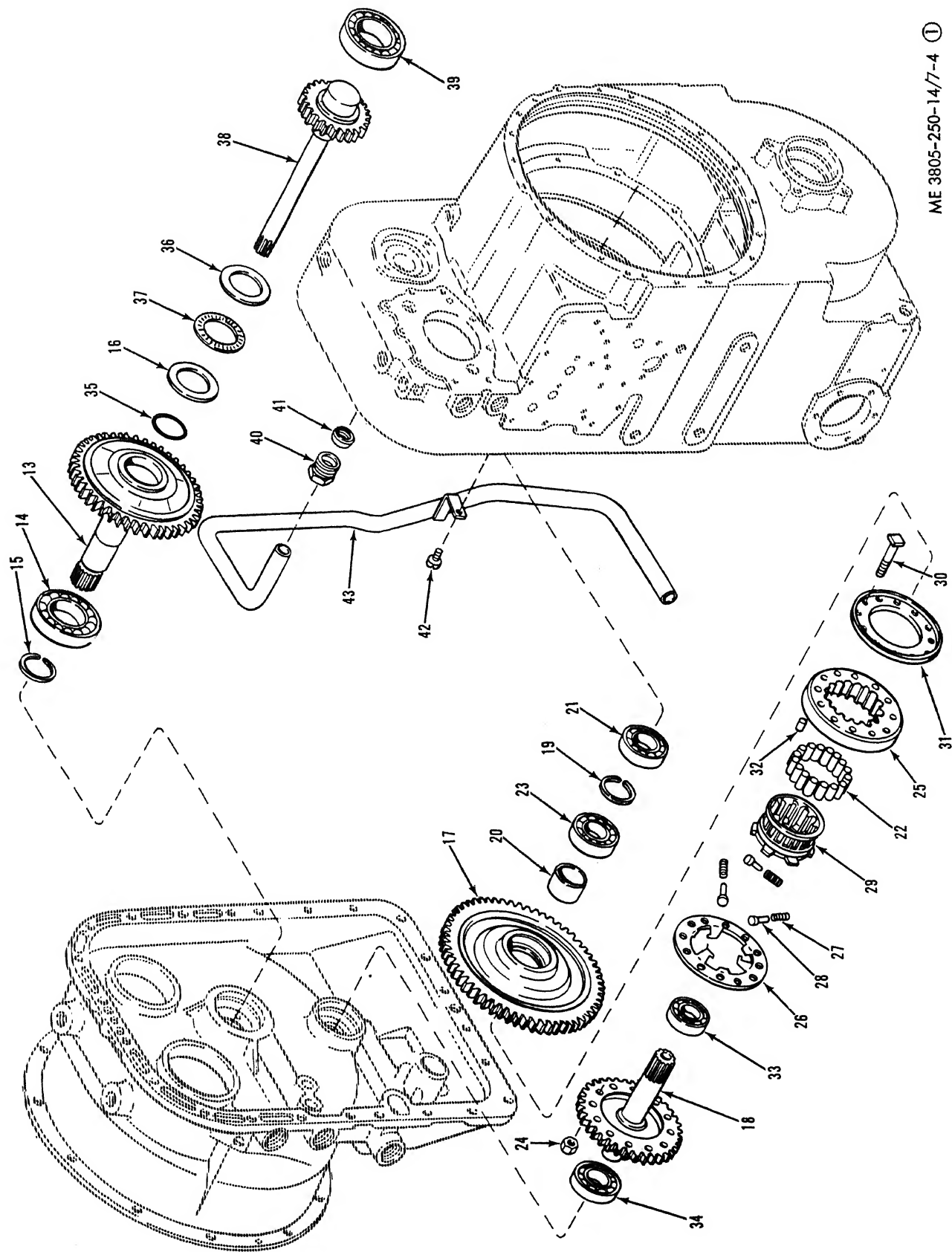
(12) Remove the forward range and reverse range sun gear (44) (sheet 2).

*Note.* Refer to sheet 2 of the illustration for steps 13 through 30.

(13) Position the transmission on its front surface. Use wood blocks to protect the front drive flange and machined surfaces.

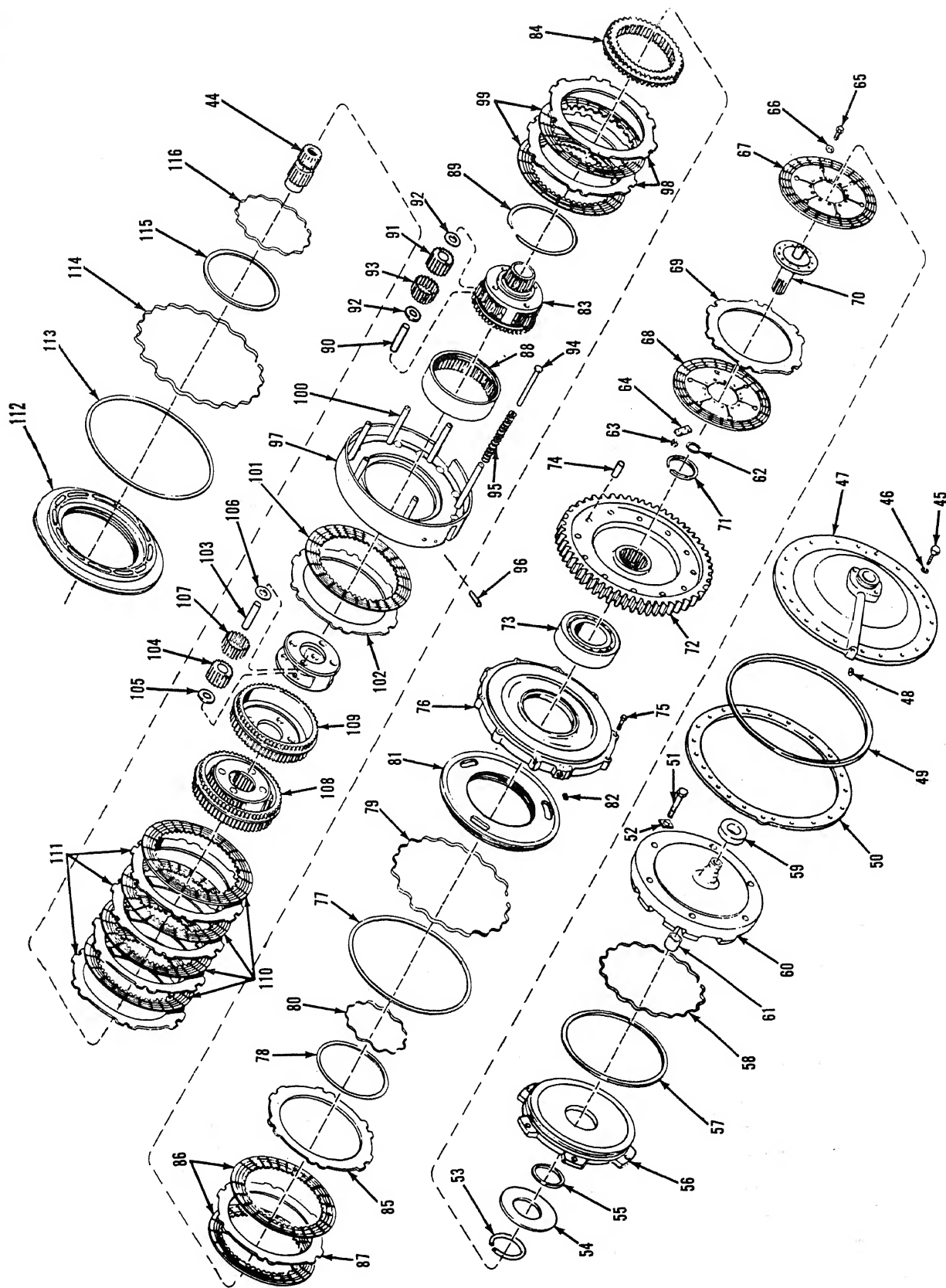
#### KEY to fig. 7-4:

- |                                  |  |                         |
|----------------------------------|--|-------------------------|
| 1. Drain plug                    | 51. Bolt                                 | 100. Pin                |
| 2. Bolt                          | 52. Lock tab                             | 101. Clutch plate       |
| 3. Bolt                          | 53. Retaining ring                       | 102. Clutch plate       |
| 4. Lockwasher                    | 54. Spring                               | 103. Pin                |
| 5. Control valve                 | 55. Seal                                 | 104. Pinion             |
| 6. Gasket                        | 56. Piston                               | 105. Thrust washer      |
| 7. Bolt                          | 57. Seal                                 | 106. Thrust washer      |
| 8. Bolt                          | 58. Ring expander                        | 107. Roller             |
| 9. Lockwasher                    | 59. Bearing                              | 108. Clutch hub         |
| 10. Lockwasher                   | 60. Clutch housing                       | 109. Carrier            |
| 11. Charging pump assembly       | 61. Bushing                              | 110. Clutch plate       |
| 12. Gasket                       | 62. Retaining ring                       | 111. Clutch plate       |
| 13. Second turbine drive gear    | 63. Nut                                  | 112. Piston             |
| 14. Bearing                      | 64. Lock plate                           | 113. Seal               |
| 15. Seal                         | 65. Bolt                                 | 114. Expander ring      |
| 16. Bearing race                 | 66. Washer                               | 115. Seal               |
| 17. First turbine driven gear    | 67. Clutch plate                         | 116. Expander ring      |
| 18. Second turbine driven gear   | 68. Clutch plate                         | 117. Nut                |
| 19. Spacer                       | 69. Clutch plate                         | 118. Washer             |
| 20. Spacer                       | 70. Hub                                  | 119. Rear drive flange  |
| 21. Bearing                      | 71. Retaining ring                       | 120. Spacer             |
| 22. Freewheel rollers            | 72. Transfer drive gear assembly         | 121. Bearing            |
| 23. Bearing                      | 73. Bearing                              | 122. Spacer             |
| 24. Nut                          | 74. Pin                                  | 123. Transfer gear      |
| 25. Cam                          | 75. Bolt                                 | 124. Oil seal           |
| 26. Spring plate                 | 76. Low range clutch piston housing      | 125. Nut                |
| 27. Spring                       | 77. Seal                                 | 126. Washer             |
| 28. Spring guide pin             | 78. Seal                                 | 127. Front drive flange |
| 29. Roller cage                  | 79. Ring expander                        | 128. Oil seal           |
| 30. Bolt                         | 80. Ring expander                        | 129. Retaining ring     |
| 31. Retainer plate               | 81. Piston                               | 130. Bearing            |
| 32. Pin                          | 82. Plug                                 | 131. Output shaft       |
| 33. Bearing                      | 83. Low range planetary carrier assembly | 132. Bolt               |
| 34. Bearing                      | 84. Ring gear                            | 133. Lockwasher         |
| 35. Seal                         | 85. Clutch plate                         | 134. Strainer assembly  |
| 36. Bearing race                 | 86. Clutch plate                         | 135. Gasket             |
| 37. Thrust bearing               | 87. Clutch plate                         | 136. Bolt               |
| 38. First turbine drive gear     | 88. Ring gear                            | 137. Lockwasher         |
| 39. Bearing                      | 89. Retaining ring                       | 138. Cover              |
| 40. Compression nut              | 90. Pin                                  | 139. Gasket             |
| 41. Seat                         | 91. Pinion                               | 140. Plug               |
| 42. Capscrew                     | 92. Thrust washer                        | 141. Oil level tube     |
| 43. Oil suction tube             | 93. Bearing roller                       | 142. Oil level tube     |
| 44. Forward and reverse sun gear | 94. Guide pin                            | 143. Breather           |
| 45. Bolt                         | 95. Spring                               | 144. Plug               |
| 46. Lockwasher                   | 96. Anchor pin                           | 145. Plug               |
| 47. Cover                        | 97. Anchor                               | 146. Plug               |
| 48. Plug                         | 98. Clutch plate                         | 147. Case               |
| 49. Seal                         | 99. Clutch plate                         | 148. Gasket             |
| 50. Gasket                       |  |                         |



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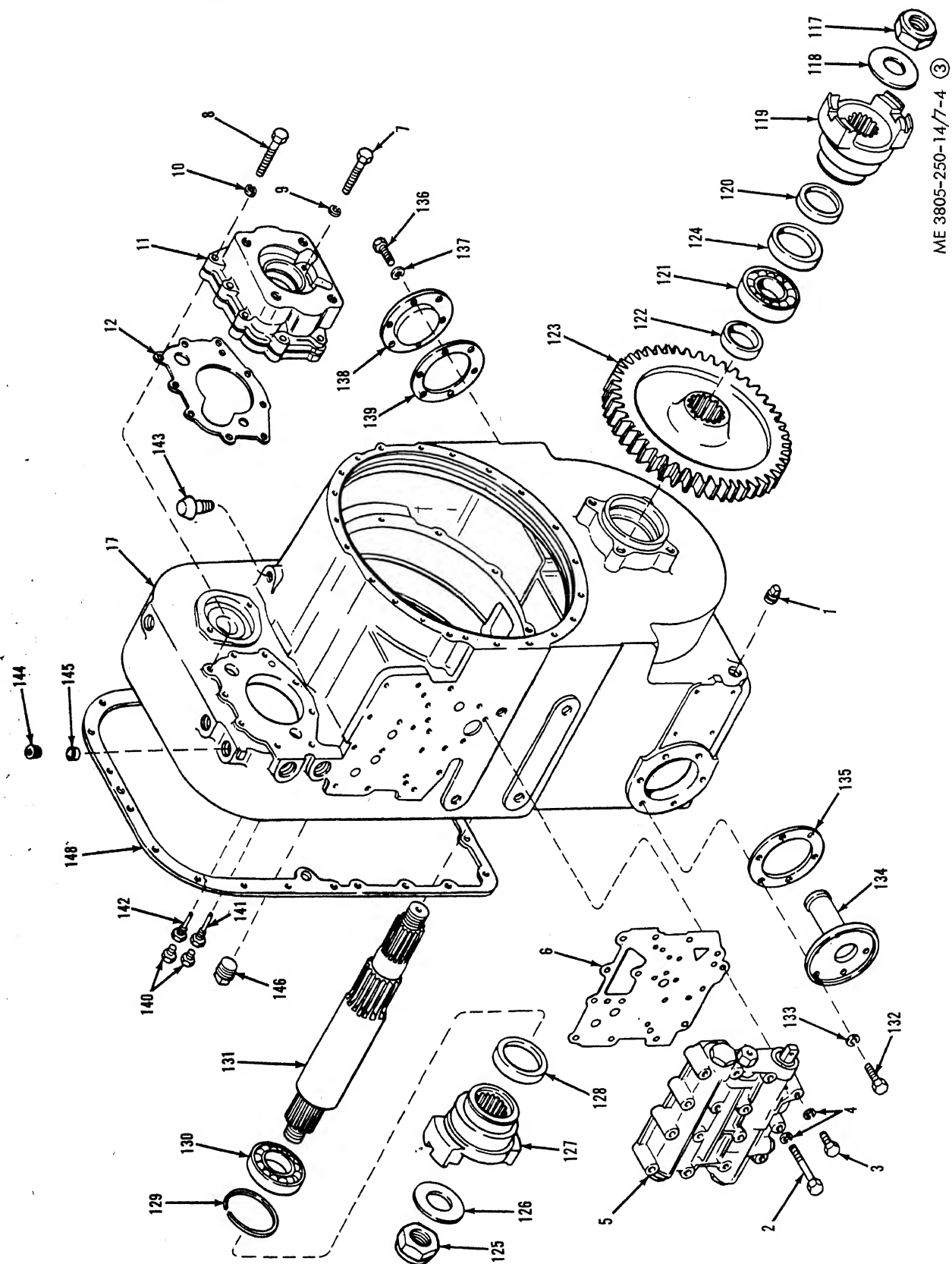
Figure 7-4. Transmission, exploded view (Sheet 1 of 3).



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Figure 7-4. Transmission, exploded view (Sheet 2 of 3).





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Figure 7-4. Transmission, exploded view (Sheet 3 of 3).



(14) Remove bolts (45) and lockwashers (46) securing rear cover (47) to the transmission. Remove plug (48), seal (49) and gasket (50) from the cover.

(15) Straighten the corners of lock tabs (52) and remove the six bolts (51) retaining the high range clutch piston housing. Using two screwdrivers, pry the piston housing assembly from the transmission.

(16) Depress piston return spring (54) and remove retaining ring (53). Remove spring (54), seal (55), piston (56), seal (57), ring expander (58) and bearing (59) from clutch housing (60). Drive bushing (61) from the piston housing if replacement is required.

(17) Remove the high range clutch hub assembly as a unit. Remove retaining ring (62) from the hub (70). Bend down corners of lock plates (64) and remove nuts (63), lock plates (64), bolts (65), washers (66), and clutch plates (67, 68, and 69) from the hub (70).

(18) Remove retaining ring (71) from the low range planetary carrier (83). Remove the transfer drive gear assembly (72), pull bearing (73) and press pins (74) from the gear.

(19) Remove two of the ten self-locking bolts (75), 180 degrees apart, from the low range clutch piston housing (76). Install two  $\frac{3}{8}$ -16 NC x 2- $\frac{1}{2}$  inch restraining bolts in their place as shown in figure 7-5.

LOW RANGE  
PISTON HOUSING

SELF-LOCKING  
BOLTS

RESTRAINING BOLTS  
 $\frac{3}{8}$  INCH - 16NC X 2- $\frac{1}{2}$  INCH

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(20) Remove the remaining eight self-locking bolts (75, fig. 7-4) from the piston housing. Evenly loosen the two restraining bolts, until pressure on the piston housing is relieved. Remove the low range clutch piston and housing as a unit.

(21) Remove seals (77 and 78) and ring expanders (79 and 80) from piston (81). Separate piston and housing (76). Remove plug (82) from housing.

(22) Remove the low range planetary carrier assembly (83), low range ring gear (84), clutch plates (85, 86, and 87), and reverse range ring gear (88) as a unit. Separate the clutch plates and low range ring gear from the planetary carrier. Remove retaining ring (89) and separate the reverse range ring gear (88) from the planetary carrier (83).

**CAUTION: Do not drill into the carrier. Careful centering of the drill on the pin will prevent damage to the carrier.**

*Note.* Do not disassemble the low range planetary carrier unless it is badly worn or has failed. Replacement of one pinion necessitates replacement of all four pinions.

(23) To disassemble the planetary carrier, drill into the ends of the pinion pins with a  $\frac{3}{4}$  inch drill, at the rear of the carrier.

(24) Press the pinion pins (90) from the carrier (83). This will free the pinions (91), thrust washers (92) and bearing rollers (93).

(25) Remove the piston return springs (95) and guide pins (94) from the reverse and low range clutch anchor (97). Remove retaining bolt from the transmission valve mounting surface, and remove clutch anchor pin (96). Remove clutch anchor (97) and clutch plates (98 and 99). Remove pins (100) from the clutch anchor if necessary.

(26) Remove clutch plates (101 and 102) and reverse range planetary carrier.

**CAUTION: Do not drill into the carrier. Careful centering of the drill on the pin will prevent damage to the carrier.**

*Note.* Do not disassemble the reverse range planetary carrier unless it is badly worn or has failed. Replacement of one pinion necessitates replacement of all four pinions.

(27) To disassemble the reverse range planetary carrier, drill into the ends of the pinion pins with a  $\frac{3}{4}$  inch drill on the clutch hub side.

(28) Press the pinion pins (103) from the carrier (109). This will free the pinions (104), the thrust washers (105 and 106), rollers (107), and clutch hub (108).

(29) Remove the reverse range clutch plates (110 and 111).

(30) Remove the reverse range piston (112), and separate the seals (113 and 115), and expander rings (114 and 116) from piston (112).

*Note.* Refer to sheet 3 of the illustration for steps 31 through 36.

Figure 7-5. Low range clutch piston removal.

(31) Remove nut (117), washer (118), rear drive flange (119), spacer (120), bearing (121), spacer (122) and transfer gear (123) from the rear end of the output shaft (131). Remove the oil seal (124).

(32) Remove nut (125), washer (126) and front drive flange (127) from the output shaft (131).

(33) Pull the front oil seal (128) from the transmission case. Remove the retaining ring (129). Drive the output shaft (131) forward until the bearing (130) is free of the bore. Remove and separate the shaft (131) and bearing (130).

(34) Remove bolts (132) and lockwashers (133), and remove strainer assembly (134) and gasket (135).

(35) Remove bolts (136) and lockwashers (137). Separate cover (138) and gasket (139) from the transmission case.

(36) Remove plugs (140) and oil level tubes (141 and 142). Remove breather (143) and plugs (144, 145, and 146) from the case (147). Scrape gasket (148) from the case.

#### c. Cleaning, Inspection and Repair.

(1) Clean all parts with solvent and dry with compressed air or clean lint free cloths. Flush bearings thoroughly to remove packed deposits in the races. After cleaning allow the bearings to air dry. Do not spin bearings or use compressed air to dry them, as damage due to lack of lubrication may occur. Use a soft wire to clean oil passages in the transmission components, and flush thoroughly with cleaning solvent.

(2) Inspect the clutch plates for cracks, burrs, scoring, galling, distortion, cone, and wear. The amount of cone is determined by measuring the distance between the inside diameter of the plate and a level surface. Refer to figure 7-6. Friction faced clutch plates are  $0.153 \pm 0.003$  inch thick with permissible wear of 0.020 inch. Allowable cone is 0.012 inch. Steel clutch plates are  $0.115 \pm 0.008$  inch thick with permissible wear of 0.010 inch. Allowable cone is 0.030 inch. Minimum clutch pack thickness for the high range clutch is 0.357 inch. Minimum clutch pack thickness for the low range clutch is 0.681 inch. Minimum clutch pack thickness for the reverse range clutch is 1.185. Replace plates having the most wear with new plates to increase clutch pack thickness.

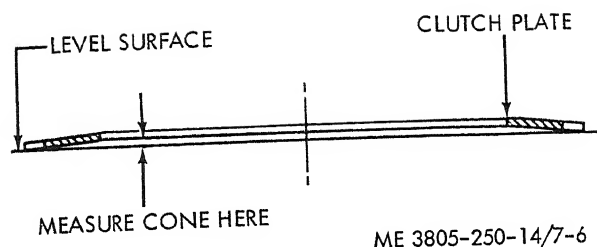


Figure 7-6. Measuring clutch plate cone.

(3) Inspect all gears and splined shafts for cracks, broken teeth, burrs scoring and wear. Remove burrs and light scoring with a soft stone or crocus cloth. Replace worn or badly damaged gears and shafts.

(4) Inspect the clutch pistons, anchor assembly, piston housings and transmission case for cracks, wear, and damage to the machined surfaces. Repair or replace parts as needed.

(5) Inspect all springs for cracks, permanent set, and other damage. Replace damaged or weak springs.

(6) Inspect all bearings for scratches, nicks, pitting, scoring, flat spots, and wear. Replace damaged or worn bearings.

(7) Inspect all other parts for cracks, breaks, scoring, other damage, and wear. Repair or replace parts as needed.

#### d. Reassembly. Refer to figure 7-4.

Note. Refer to sheet 3 of the illustration for steps 1 through 7.

(1) Install the transfer driven gear (123) into the rear of the transmission case. Install the output shaft (131) double splined end first, through the front of the case, and through the splined hub of the transfer gear.

(2) Start bearing (130), shielded side last, into the front bore of the case. Install spacer (122) on the rear end of the shaft, and start bearing (121), loading groove first, into the case bore, pushing the spacer towards the transfer gear. Support the front of the shaft, and drive the rear bearing (121) and spacer (122) forward until they seat against the gear hub. Drive the front bearing (130) against its

seat, and install retaining ring (129).

(3) Reseat the rear bearing, if needed, and install the front seal (128) and rear seal (124). Apply a coating of nonhardening sealant to the outer circumference of the seals, and install them lip first into their respective bores. Lightly drive the seals until they seat squarely in the bores.

(4) Install the front drive flange (127) and rear drive flange (119). Lubricate the threads of nuts (117 and 125) with molykote G and install washers (118 and 126) and nuts. Hold the flange and tighten the nuts to 600 to 700 pound-feet.

(5) Install new gasket (135) and strainer assembly (134), and secure with bolts (132) and lockwashers (133). Tighten the bolts to  $29 \pm 3$  pound-feet.

(6) Install new gasket (139) and cover (138), and secure with bolts (136) and lockwashers (137). Tighten the bolts to  $29 \pm 3$  pound-feet.

(7) Install oil level tubes (141 and 142) and pipe plugs (140). Tighten plugs firmly to prevent oil leakage.

*Note.* Refer to sheet 2 of the illustration for steps 8 through 32.

(8) Insert the expander ring (116) into the inner groove of piston (112). The free ends of the expander ring must turn inward away from the seal. Oil the seal (115) and groove, and start the seal into the groove opposite the gap in the expander ring. Work the seal into the groove, compressing the expander ring while working in both directions from the starting point. Do not stretch or distort the seal more than necessary.

(9) Install the external expander ring (114) with the ends of the expander ring away from the seal. Oil and install the seal (113) in exactly the same manner as the smaller ring (115).

(10) Install the assembled reverse range piston in the transmission case. Beginning with an external tanged clutch plate (111), alternately install four externally tanged clutch plates and four internal splined clutch plates (110) onto the reverse range piston.

(11) Chill new reverse range planetary pinion pins (103) in dry ice for one hour. Grind an old pin 0.005 inch undersize, and use it for an aligning tool. Install thrust washer (105) on the aligning tool. Coat the bore of a pinion (104) with oil soluble grease and install it on the aligning tool. Insert twenty-two pinion rollers (107) into the space between the pinion and the aligning tool, and install thrust washer (106). Repeat for each pinion.

(12) Position the carrier (109) with chamfered side of pin bores upward, on a level surface. Slide the aligning tool out of the assembled pinion, and install the pinion in the carrier. Insert the aligning

tool to properly align pinion parts in the carrier. Repeat for each pinion.

(13) Place the carrier and pinions on the clutch hub (108). Align the hub and carrier holes with the aligning tool. Start a chilled pin (103) into the pin bore and press it in until it projects  $0.140 \pm 0.010$  inch beyond the face of the clutch hub as shown in figure 7-7. Repeat for each pinion.

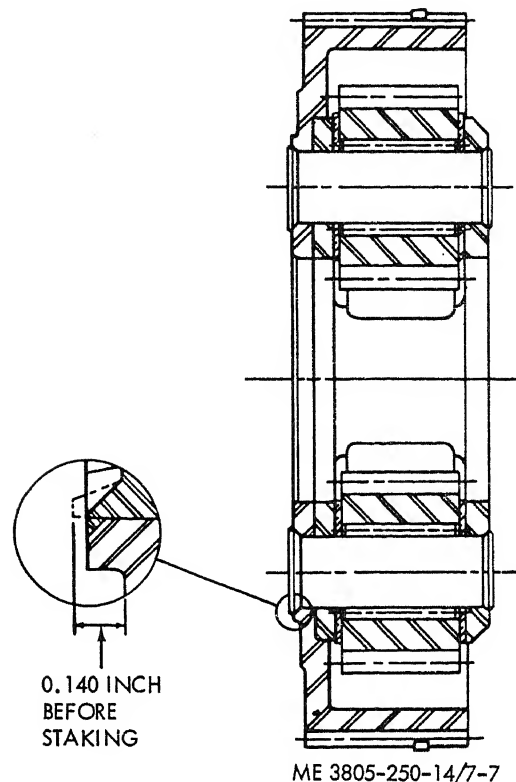


Figure 7-7. Reverse range planetary pinion pin installation.

(14) Fabricate an octagon punch as shown in figure 5-14, and stake the ends of the pinion pins. The pinion must rotate freely after the staking operation.

(15) Install the assembled reverse range planetary carrier, long splines first, into the reverse range clutch plates. Install one external tanged clutch plate (102, fig. 7-3) and one internal spline clutch plate (101) on the reverse range planetary carrier.

(16) Align the slots of the external tanged reverse range clutch plates to receive six pins of the clutch anchor (97). Install clutch anchor and the clutch anchor pin (96), aligning the pin with the slot in the anchor assembly. Refer to figure 7-8. Temporarily install a  $\frac{3}{8}$ -16 NC x 1 inch bolt and

flat washer (items 122 and 123, fig. 7-4, sheet 3) to retain the clutch anchor pin (96, sheet 2).

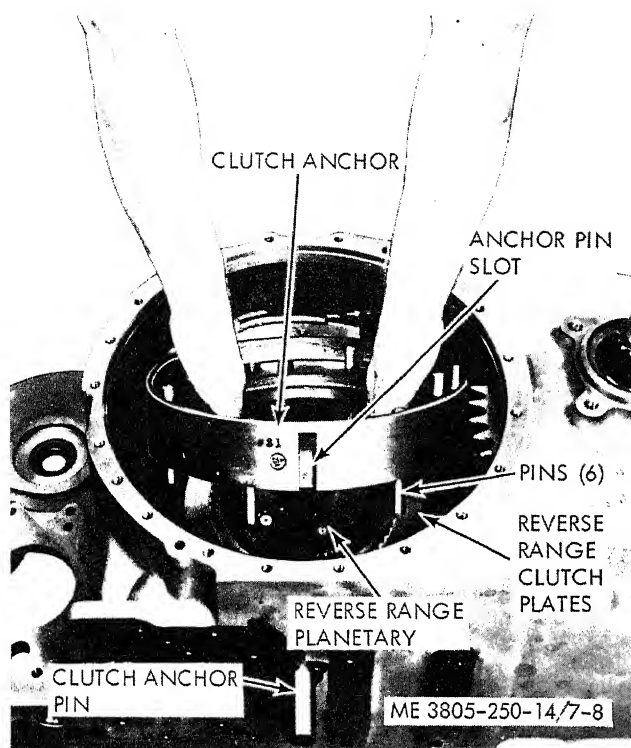


Figure 7-8. Installing clutch anchor.

(17) Chill new low range planetary piston pins (90) in dry ice for 1 hour. Using the same aligning tool as was used for the reverse range planetary pinions, install a thrust washer (92) on the tool. Coat the bore of a pinion (91) with oil soluble grease and install it on the aligning tool. Insert twenty-two pinion rollers (93) into the space between the pinion and the aligning tool, and install the remaining thrust washer (92). Repeat for each pinion.

(18) Position the carrier (83), hub upward, on a level surface. Slide the aligning tool out of the assembled pinion and install the pinion in the carrier. Insert the aligning tool to properly align the pinion parts in the carrier. Repeat for each pinion.

(19) Position the carrier, hub upward, in a press. Start a chilled pin (90) into the pin bore, and press it in until the pin is 0.180 inch below the shoulder surface as shown in figure 7-9. Repeat for each pinion.

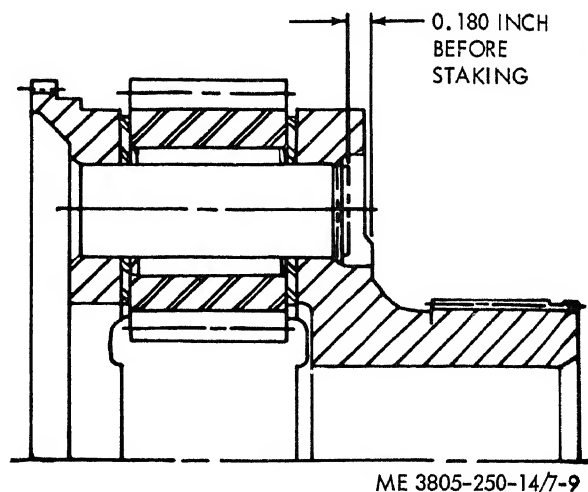


Figure 7-9. Low range planetary pinion pin installation.

(20) Stake the ends of the pinion pins, using the octagon punch that was used on the reverse range planetary pinion pins. The pinions must rotate freely after the staking operation.

(21) Assemble the reverse range ring gear (88, fig. 7-4) and the low range planetary assembly. Retain ring gear with retaining ring (89). Install the assembly in the transmission, engaging the teeth of the reverse range ring gear with the reverse range planetary pinions.

(22) Place an external tanged clutch plate (98) between two internal splined clutch plates (99), and install them on low range ring gear (84) on the flat side. Position the gear and clutch plates on the low range planetary carrier, engaging the slots of the external tanged plate with the clutch anchor pins.

(23) Starting with an external tanged clutch plate (98), alternately install three external tanged plates (85 and 87) and two internal splined clutch plates (86) onto the low range ring gear (84). Install the twelve piston return springs (95) and guide pins (94) in the holes in the clutch anchor assembly.

(24) Insert the internal seal ring expander (80) into the inner groove of piston (81). The free ends of the expander must turn inward away from the

seal. Oil the seal (78) and the groove, and start the seal into the groove opposite the gap in the expander. Work the seal into the groove, compressing the expander while working in both directions from the starting point. Do not stretch or distort the seal more than necessary.

(25) Install the external ring expander (79) with the ends of the expander away from the seal. Oil and install the seal (77) in exactly the same manner as the smaller ring (78).

(26) Install the assembled piston in the low range clutch piston housing, flat side first, and install the piston and housing in the transmission. Install two  $\frac{3}{8}$ -16 NC x 2- $\frac{1}{2}$  inch bolts 180 degrees apart, and draw the housing down until the ten bolts (75) can be installed and engaged. Remove the two long bolts and install the remaining two bolts (75). Tighten the bolts to 36 to 43 pound-feet.

(27) Press pins (74) into transfer gear (72) if pins were removed. Press the pins until they project  $0.75 \pm 0.01$  inch above the surface. Press bearing (73), ring groove first, onto the gear. Install the transfer gear assembly on the splined hub of the low range planetary carrier (83). Use a hooked tool to raise the low range planetary carrier sufficiently to permit installation of retaining ring (71).

(28) Assemble the washers (66) on bolts (65) and install the bolts into clutch plate (67). Position the clutch hub (70), unsplined end toward the bolt heads, on the clutch plate and bolts. Install external tapered plate (69) and internal splined plate (68) on the hub (70). Install the lock strips (64) and nuts (63). Tighten the nuts to  $16 \pm 2$  pound-feet, and bend the lock strip corners against the nuts. Install retaining ring (62) on the hub, and insert the hub assembly into the transfer gear hub.

(29) Press new bushing (61) into high range clutch piston housing (60). Bushing must be  $0.06 \pm 0.02$  inch below the front surface of the housing hub. Install seal (55) on the housing hub. Press bearing (59) onto the piston housing.

(30) Insert the seal ring expander (58) into the groove in piston (56). The free ends of the expander must turn away from the seal. Oil the seal (57) and the groove, and start the seal into the groove opposite the gap in the expander. Work the seal into the groove, compressing the expander, while working in both directions from the starting point. Do not stretch or distort the seal more than necessary.

(31) Install the assembled piston in housing (60). Place the piston return spring (54), convex side up, on the piston. Depress the piston return spring in a press and install retaining ring (53). Install the piston and housing assembly on the transfer gear. Align and engage the recesses in the

piston with the drive pins on the transfer gear. Use a soft hammer to seat the piston housing in the recess in the transfer gear. Install lock tabs (52) and bolts (51). Tighten the bolts to 83 to 100 pound-feet, and secure by bending the tabs against the bolt heads.

(32) Install seal ring (49) on cover (47). If removed, install plug (48) in the cover. Piston a new gasket (50) on the transmission case, and place the cover on the transmission. Install bolts (45) and lockwashers (46). Tighten the bolts to  $29 \pm 3$  pound-feet.

(33) Turn the transmission over with the front side up. Rest the transmission on wood blocks.

*Note.* Refer to sheet 1 of the illustration for steps 34 through 43.

(34) Install the reverse range and low range sun gear (44) in the transmission.

(35) Pressbearing (39) on first turbine drive gear (38). Install the drive gear and bearing in the transmission. Install seal ring (35) on the first turbine drive gear hub, and place the thrust bearing race (36) and thrust bearing (37) on the first turbine drive gear.

(36) Press bearings (33 and 34) on the second turbine driven gear (18).

(37) Press roll pin (32) into cam (25), until it bottoms in its bore. Align the match marks on the cam (25) and roller cage (29) and insert the cage into the cam. Insert the fifteen rollers (22) into the cage pockets. Use oil soluble grease, if needed, to retain the rollers. Fabricate and install a replacer sleeve having a diameter of 3.032 to 3.037 inches and at least 1.75 inches long to aid in retaining the rollers during subsequent operations.

(38) Install springs (27) and guide pins (28) in the ears on the roller cage (14). Install the spring retainer plate (26) on the cam, rotating it slightly until the hole in the retainer plate engages the roll pin in the cam. Install retainer plate (31) and bolts (30). The heads of the bolts must be positioned against the flange on the plate. Stretch a rubber band around the bolt circle to retain the bolts while repositioning the assembly.

(39) Position the first turbine driven gear (17) long hub up, on a level surface, and slide the assembled cam onto the gear. The replacer sleeve will be pushed out by the gear hub. Remove the rubber band from the bolts, making sure the bolts remain within the flange of retainer plate (31). Bolts cannot rotate when properly positioned.

(40) Install the second turbine driven gear (18), splined end first, on the cam assembly, and secure with nuts (24). Tighten the nuts to  $45 \pm 4$  pound-feet. Turn the assembly over and install spacer (20) and bearing (23), spacer (11) and

bearing (21). Press them firmly in place while supporting the first turbine driven gear. Spacer (20) must be accurately centered to prevent it from hanging up on the shaft shoulder of second turbine driven gear (18).

(41) Install the turbine driven gears and freewheel clutch assembly as a unit, rotating the assembly to engage the second turbine driven gear spline with those of the reverse and low range sun gear (44, sheet 2).

(42) Install the compression nut (40) and sleeve (41) on the oil suction tube (43). Position the suction tube in the transmission case, and secure with bolt (42). Tighten the bolt to 36 to 43 pound-feet. Tighten the compression nut (40)  $1\frac{1}{4}$  to  $1\frac{1}{2}$  turns after it is finger tight.

(43) Press bearing (14) onto the second turbine drive gear (13). Install seal ring (15) in its groove on the gear shaft. Place thrust bearing race (16) on the bottom of the second turbine drive gear and retain it with grease. Slide the assembly onto the first turbine drive gear shaft.

*Note.* Refer to sheet 3 of the illustration for steps 44 through 46.

(44) Install the transmission oil pump assembly (11) and a new gasket (12). Install bolts (7 and 8) and washers (9 and 10) and tighten bolts to  $29 \pm 3$  pound-feet.

(45) Remove the bolt and flat washer retaining the clutch anchor pin (95), and install transmission control valve (5) and a new gasket (6). Install valve

mounting bolts (2 and 3) and washers (4). Tighten the bolts to  $29 \pm 3$  pound-feet, starting at the center of the valve and working outward.

(46) Install drain plug (1), breather (142) and plugs (143, 144 and 145).

*e. Installation.*

(1) Assemble and install the torque converter on the transmission as described in paragraph 7-2.

(2) Install the transmission and engine as a unit as described in paragraph 5-7.

#### **7-4. Transmission Oil Pump**

*a. Removal.*

(1) Refer to paragraph 8-8 and remove the hydraulic system pump.

(2) Remove the nine bolts (7 and 8, fig. 7-4) and lockwashers (9 and 10) securing the pump to the transmission case, and remove the pump (11) from the transmission. Remove and discard the gasket (12).

*b. Disassembly.* (Refer to figure 7-10.)

(1) Separate cover (1) from the pump. Remove and discard gasket (2).

(2) Remove the drive gear (3) and driven gear (4) from the body (9). Remove shaft (6).

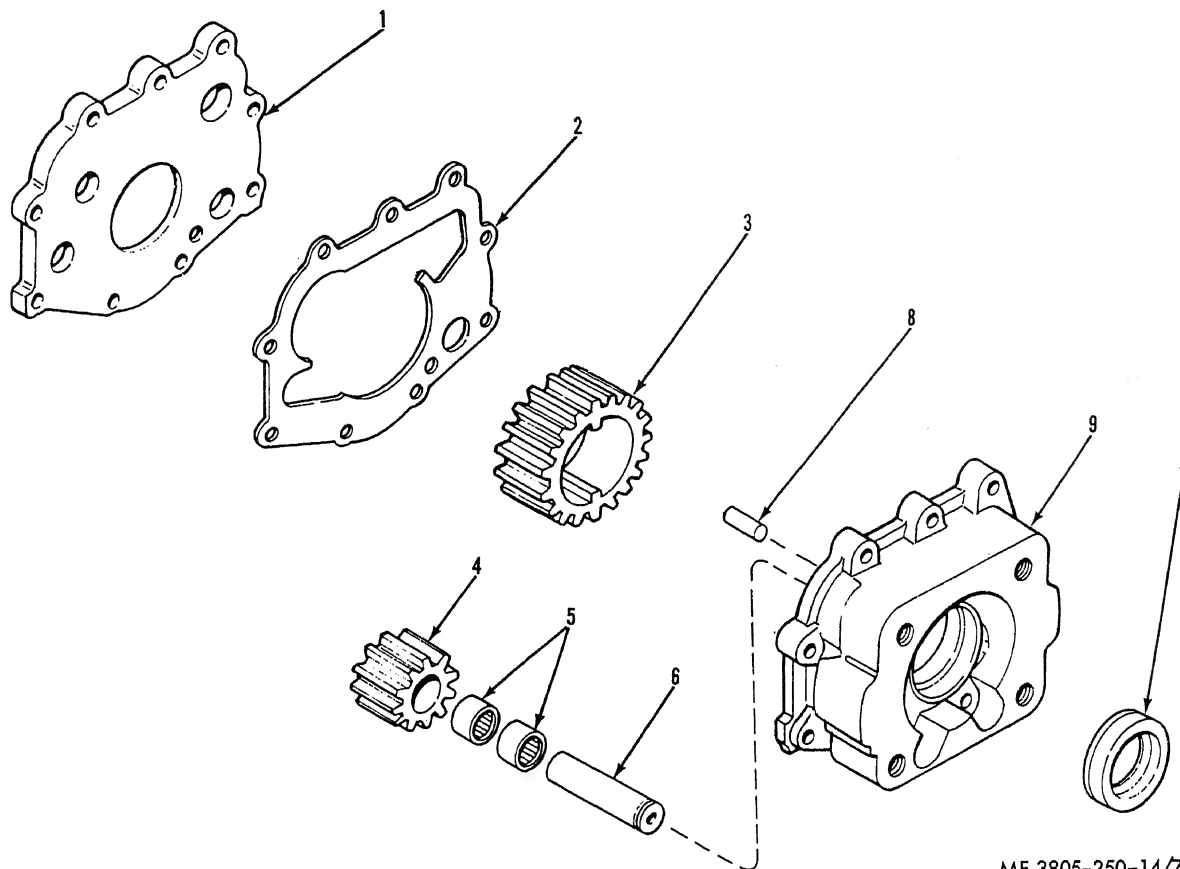
(3) Remove bearings (5) from the driven gear if replacement is necessary.

(4) Remove oil seal (7) from the pump body.

(5) Remove dowel pin (8) if replacement is required.

*Note.* Dowel pin (8) can be removed by clamping the pin in a vise and rotating the body.





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- |                |              |
|----------------|--------------|
| 1. Cover       | 6. Shaft     |
| 2. Gasket      | 7. Oil seal  |
| 3. Drive gear  | 8. Dowel pin |
| 4. Driven gear | 9. Body      |
| 5. Bearing     |              |

Figure 7-10. Transmission oil pump, exploded view.

**c. Cleaning, Inspection and Repair.**

(1) Clean all parts thoroughly with solvent and dry them with compressed air. Do not use compressed air to dry the bearings.

(2) Inspect the gears, shaft, cover, and body for cracks, nicks, burrs, scratches, scoring, and wear. Remove burrs and minor surface irregularities with a soft honing stone or crocus cloth. Replace pump assembly if gears, body, or shaft are damaged or worn.

(3) Inspect bearings for nicks, scratches, pitting and wear. Replace damaged or worn bearings.

**d. Reassembly.** Refer to figure 7-10.

(1) If removed, press new dowel pin (8) into the pump body. Pin must project  $0.42 \pm 0.01$  inch when installed.

(2) Press bearings (5) into the driven gear (4). Bearing drive should rest on the identification number end of the bearing. Bearings must be flush to 0.020 inch below the end of the gear.

(3) Coat the outer circumference of the oil seal (7) with a nonhardening sealant, and press it into the body, lip side first.

(4) Install the driven gear (4) and drive gear (3) in the body. The gears must project 0.002 to 0.003 inch above the pump surface. If end face of gear is below the surface of the body, the pump will

not perform satisfactorily and must be replaced.

(5) Fill the pump with transmission oil, install new gasket (2) and install the pump cover (1).

*e. Installation.*

(1) Install a new gasket on the pump cover and position the pump on the transmission. Install the nine pump mounting bolts and tighten them to  $29 \pm 3$  pound-feet.

(2) Install the hydraulic system pump as described in paragraph 8-8.

## 7-5. Transmission Control Valve

*a. Removal.*

(1) Disconnect the clutch cutout air line at the valve. Refer to figure 7-11.

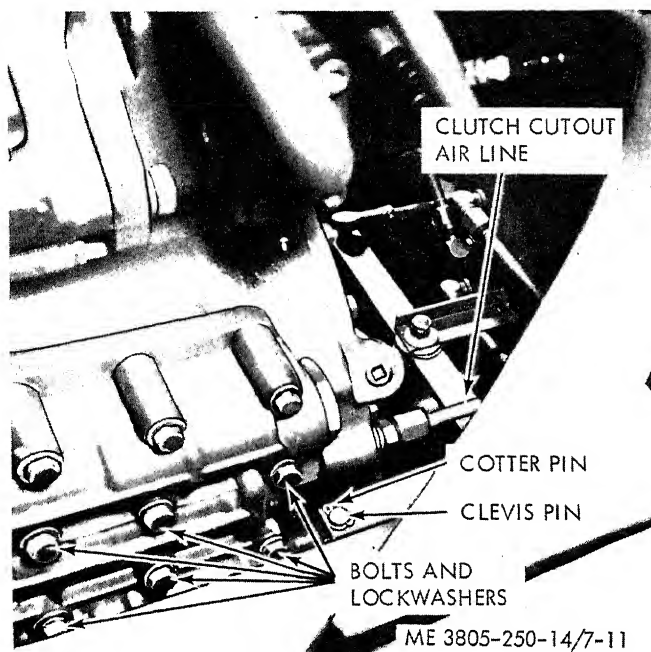


Figure 7-11. Transmission control valve, removal and installation.

(2) Remove cotter pin and clevis pin attaching the transmission shift linkage to the valve spool.

(3) Remove fifteen  $\frac{3}{8}$ -16 NC x 2- $\frac{1}{2}$  inch bolts and lockwashers, and one  $\frac{3}{8}$ -16 NC x 1 inch bolt and lockwasher.

(4) Remove the transmission control valve and the gasket from the transmission.

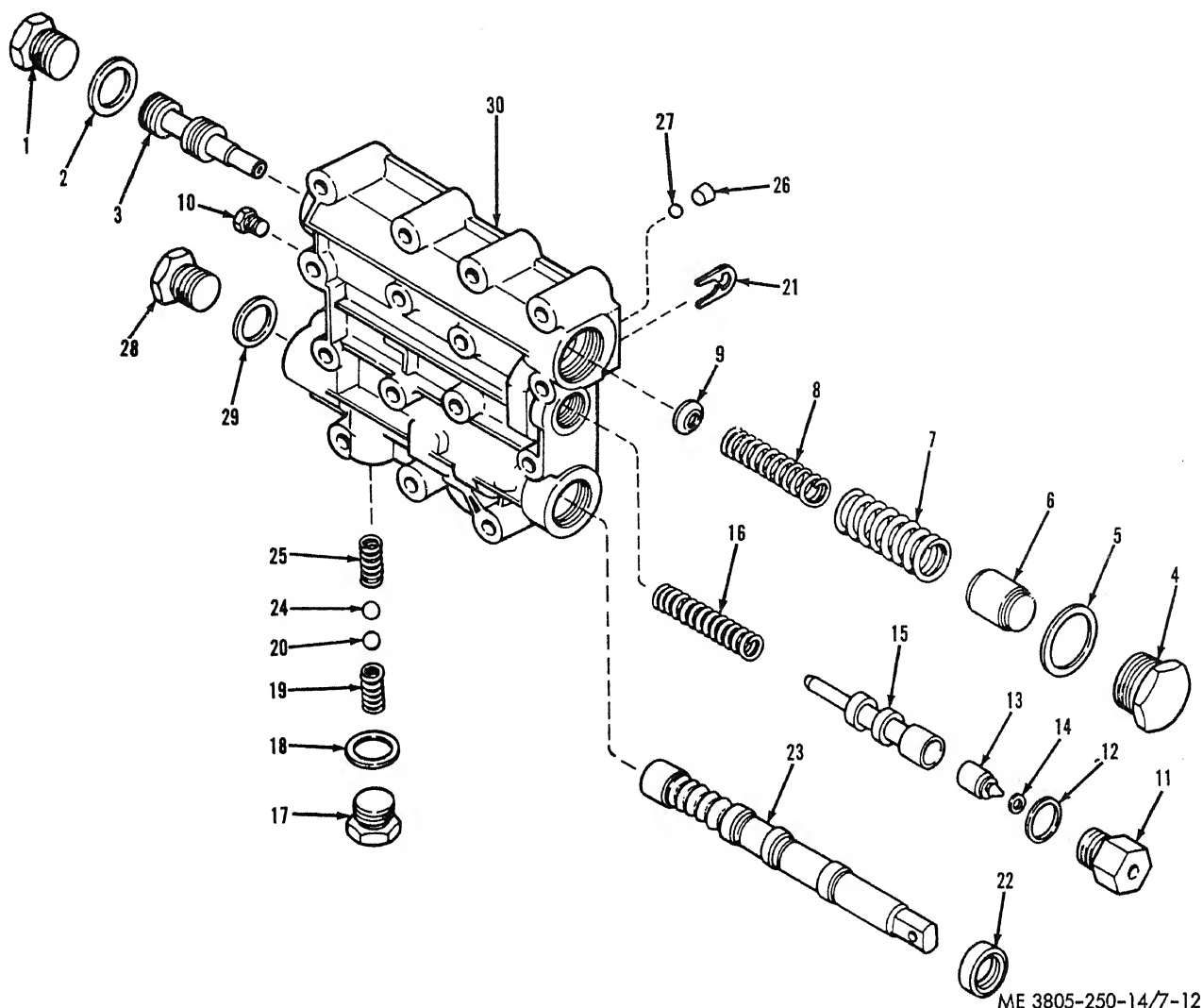
*b. Disassembly.* Refer to figure 7-12.

(1) Remove plug (1) and gasket (2) from the valve body (30), and remove the main pressure regulator valve (3).

KEY to fig. 7-12:

1. Plug
2. Gasket
3. Regulator valve
4. Plug
5. Gasket
6. Plug
7. Spring
8. Spring
9. Seat
10. Plug
11. Plug
12. Gasket
13. Plug
14. Seal
15. Valve
16. Spring
17. Plug
18. Gasket
19. Spring
20. Ball
21. Stop
22. Seal
23. Valve
24. Ball
25. Spring
26. Plug
27. Ball
28. Plug
29. Gasket
30. Body





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Figure 7-12. Transmission control valve, exploded view.

(2) Remove plug (4) and gasket (5) from the valve body. Remove trimmer plug (6), trimmer spring (7), main pressure regulator spring (8) and spring seat (9).

(3) Remove plug (10).

(4) Remove retainer plug (11) and gasket (12), and separate cut-out plug (13) from retainer plug (11). Remove seal ring (14) from plug (13). Remove cut-out valve (15) and valve spring (16) from the valve body.

(5) Remove plug (17) and gasket (18), spring (19) and ball (20). Remove valve stop (21) from its position on the range selector valve (23) at the back side of the control valve.

(6) Insert a bolt through the linkage clevis pin hole in selector valve (23). Pull the selector valve and seal (22) from the valve body, and separate the

valve and seal. Remove the remaining detent ball (24) and spring (25).

(7) Remove retainer plug (26) and ball (27) if replacement is necessary. Remove plug (28) and gasket (29) from the valve body.

#### c. Cleaning, Inspection and Repair.

(1) Clean all parts thoroughly with solvent and dry with compressed air.

(2) Inspect the valve body bores for nicks, scratches, cracks, scoring, pitting, and wear. Remove light scoring or burrs with a soft honing stone or crocus cloth, being careful not to create flat spots in the bores. Replace the entire valve assembly if the body is badly damaged or worn.

(3) Inspect the selector valve, main pressure regulator valve, the trimmer plug, and the cut-out valve for nicks, scratches, scoring, pitting, and

wear. Remove scoring and pitting with crocus cloth, being careful not to create flat spots. Replace any damaged or badly worn parts.

(4) Inspect the valve springs for cracks, permanent set and other damage. Replace damaged parts.

(5) Replace all gaskets and seals. Replace threaded plugs if thread damage cannot be repaired.

*d. Reassembly.* Refer to figure 7-12.

*Note.* Coat all parts and bores thoroughly with transmission oil at the time of assembly.

(1) Install new retainer plug (26) and ball (27) if old parts were removed. Place the plug, open end up, over the ball and press it into the valve body flush to 0.010 inch below the surface of the bosses.

(2) Install spring (25) and detent ball (24) in the valve body. Depress the ball and insert selector valve (23) through the seal bore.

(3) Install remaining detent ball (20), and spring (19). Install new gasket (18) and plug (17) to retain the spring and ball. Tighten the plug firmly.

(4) Position the selector valve (23) in the middle detent position, and install valve stop (21) at the back of the valve body.

(5) Coat the circumference of a new seal (22) with nonhardening sealer, and insert it lip first into the valve body. The seal must be flush to 0.030 inch below the valve body surface.

*Note.* At assembly, all spool valves must move freely by their own weight in their bores.

(6) Install the main pressure regulator valve (3) a new gasket (2) and plug (1) in the valve body. Tighten the plug firmly. Install plug (10), new gasket (29), and plug (28), tightening the plugs firmly to prevent leakage.

(7) Install plug (10) if removed.

(8) Install spring seat (9) on cove side first on the main pressure regulator valve stem (3). Install the main pressure regulator spring (8), trimmer spring (7) and trimmer plug (6) into the valve bore. Install a new gasket (5) and plug (4). Tighten the plug firmly.

(9) Assemble cut-out valve spring (16) onto the clutch cut-out valve (15) and install them in the valve bore. Install seal ring (14) on cut-out plug (13), and install the plug in the smooth bore end of the retainer plug (11). Install a new gasket (12), and install the retainer plug assembly, tightening the plug firmly. Cover the exposed opening in the plug until the air line is connected to it.

*e. Installation.* Refer to figure 7-11.

(1) Install a new valve to transmission gasket, using oil soluble grease to retain it on the transmission.

(2) Position the valve on the transmission and secure it with fifteen  $\frac{3}{8}$ -16 NC x  $2\frac{1}{2}$  inch bolts, one  $\frac{3}{8}$ -16 NC x 1 inch bolt, and sixteen  $\frac{3}{8}$  inch lockwashers. Evenly tighten the bolts to  $29 \pm 3$  pound-feet, starting at the center of the valve and working outward.

(3) Connect the shift linkage and insert clevis pin and its cotter pin.

(4) Connect the air line to the clutch cut-out retainer plug.

## Section II. PROPELLER SHAFTS AND CENTER BEARING

### 7-6. General

The propeller shafts and center bearing (fig. 7-13) transmit power from the transmission to the front and rear axles. Universal joints at the trans-

mission, axles, and center bearing compensate for misalignment between these members during operation of the machine.

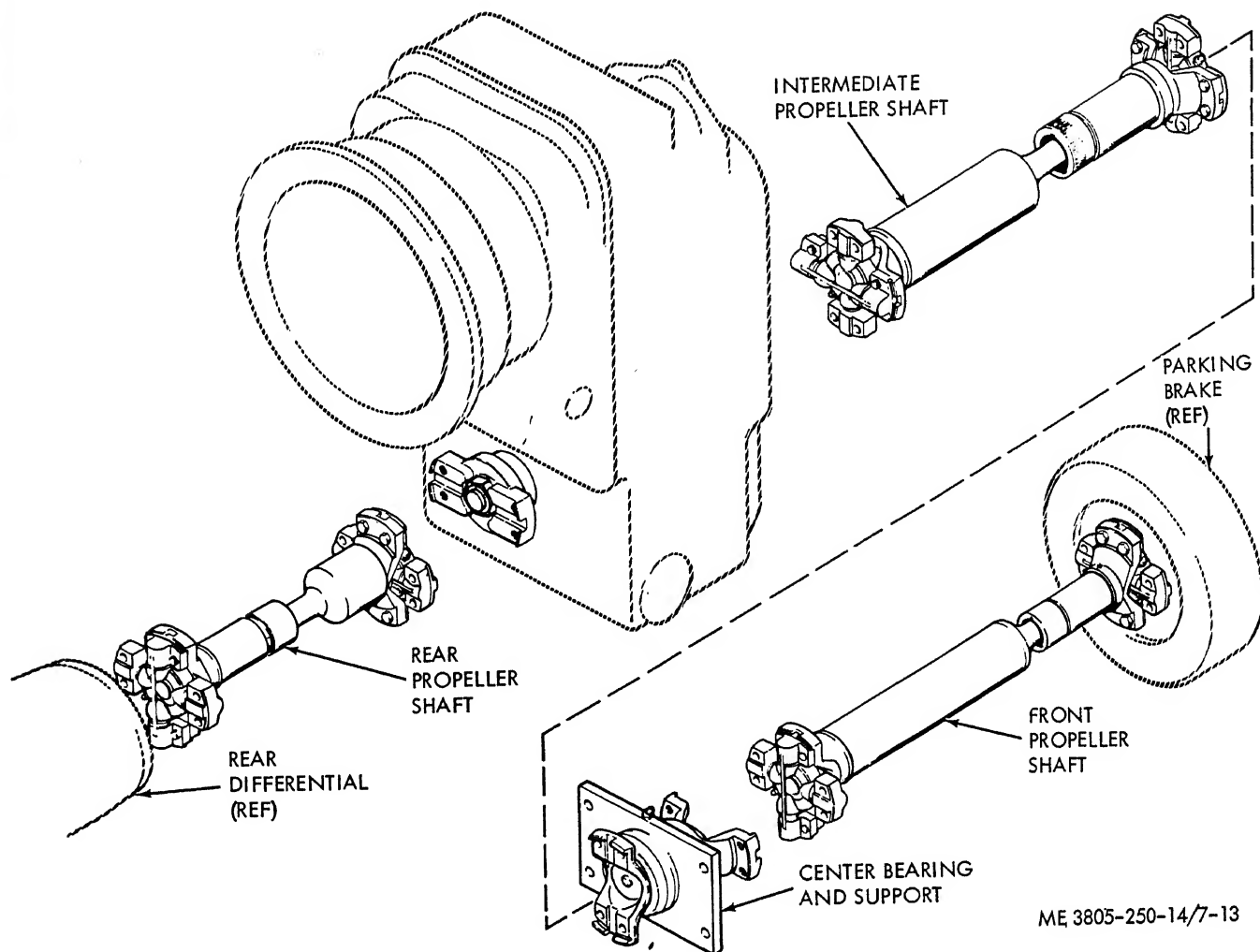


Figure 7-13. Propeller shafts installation diagram.

## 7-7. Front Propeller Shaft

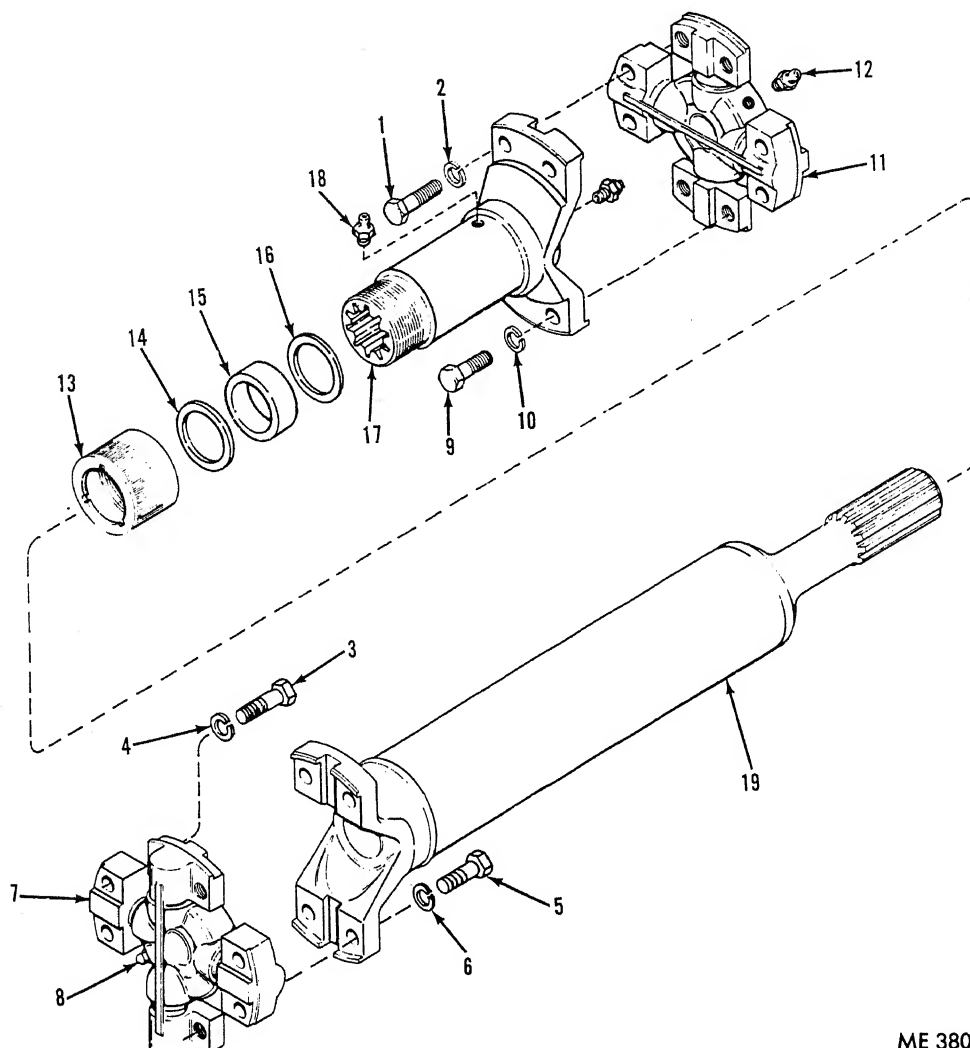
a. *Removal and Disassembly.* Refer to figure 7-14.

(1) Place the transmission range selector lever in the neutral position, and block the vehicle wheels.

(2) Remove four bolts (1) and four lockwashers (2), and separate the front propeller shaft from the parking brake companion flange.

### KEY to fig. 7-14:

1. Bolt
2. Lockwasher
3. Bolt
4. Lockwasher
5. Bolt
6. Lockwasher
7. Spider and bearing assembly
8. Fitting
9. Bolt
10. Lockwasher
11. Spider and bearing assembly
12. Fitting
13. Retaining nut
14. Felt washer
15. Felt washer
16. Felt washer
17. Slip yoke
18. Grease fitting
19. Propeller shaft



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Figure 7-14. Front propeller shaft, exploded view.

(3) Remove four bolts (3) and four lockwashers (4) and separate the rear end of the front propeller shaft from the center bearing and support flange.

(4) Remove bolts (5) and lockwashers (6) and remove spider and bearing assembly (7) and fitting (8) from the propeller shaft. In like manner remove bolts (9) and lockwashers (10) and remove spider and bearing assembly (11) from the slip yoke.

(5) Remove the fitting (12).

(6) Loosen retaining nut (13) and slide it with washers (14), (15), and (16) onto the propeller shaft (19). Slide yoke (17) from the spline on propeller shaft (19), and remove the retaining nut and felt washers. Remove grease fitting (18) from yoke.

*b. Cleaning, Inspection and Repair.*

(1) Clean all parts thoroughly with solvent, and dry with compressed air. Do not soak spider and bearing assemblies in solvent. Thoroughly clean the grease passage in the slip yoke. Use a soft wire to remove solid grease deposits in the yoke.

(2) Inspect the slip yoke, propeller shaft and spider and bearing assemblies for cracks, burrs on the flange faces, damaged threads and other damage. Remove burrs from flange faces and splines with a soft honing stone or crocus cloth. Inspect splines for twists, broken teeth, and other damage. Slide the slip yoke onto the shaft spline to check for proper fit. Replace damaged parts. Replace a twisted or bent propeller shaft.

(3) If necessary, cut the weld on one end of the bearing cap lock wire, and remove and inspect the bearing rollers and spider for damage and wear. If bearings and spider are satisfactory, lubricate and

reinstall bearings and caps. Tack weld the lock wire to retain the caps. If one of the bearings or the spider is worn, replace the entire spider and bearing assembly.

(4) Replace the felt washers (15).

*c. Reassembly and Installation.* Refer to figure 7-14.

(1) Slide the retaining nut (13) and washers (14, 15, and 16) onto the propeller shaft (19).

(2) Coat the splines of the propeller shaft with grease and slide the slip yoke (17) onto the spline. Slide the felt washers and retaining nut forward, and engage the threads of the nut with the threads on the slip yoke. Tighten the retainer nut slightly more than finger-tight. Lubricate the slip yoke thoroughly, and install grease fitting (18).

(3) Install spider and bearing assembly (11) on the slip yoke and secure with bolts (9) and lockwashers (10). Tighten the bolts to  $35 \pm 5$  pound-feet. In like manner, install spider and bearing assembly (7), bolts (9) and lockwashers (10) on the propeller shaft (19). Lubricate the spider and bearing assemblies.

(4) Position the propeller shaft assembly on the center bearing flange and install bolts (3) and lockwashers (4). Tighten the bolts to  $35 \pm 5$  pound-feet. Position the propeller shaft on the flange on the parking brake and install the bolts (1) and lockwashers (2). Tighten the bolts to  $35 \pm 5$  pound-feet.

(5) Install the fitting (12).

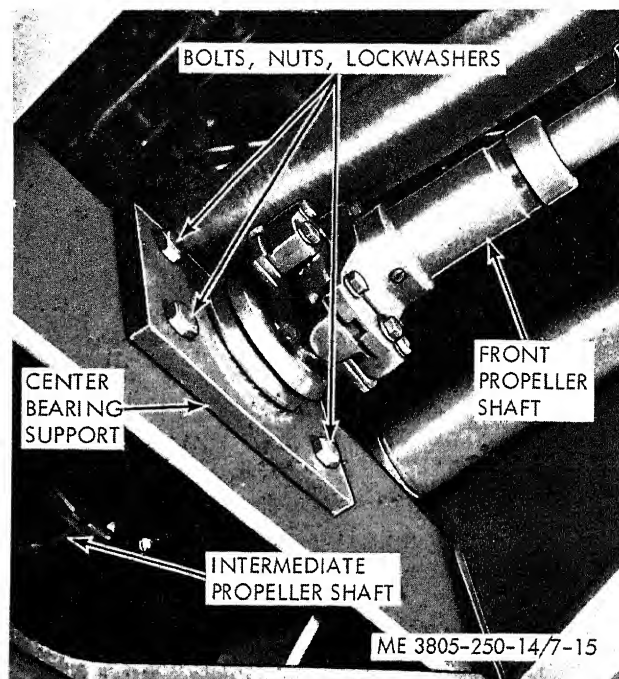
(6) Remove blocking from the wheels.

## 7-8. Center Bearing and Support

### *a. Removal and Disassembly.*

(1) Disconnect the front propeller shaft and the intermediate drive shaft at the center bearing flanges, after blocking the vehicle wheels. Refer to figure 7-15.

(2) Remove four nuts (1, fig. 7-16) four lockwashers (2) and four bolts (3) securing the center bearing support to the front chassis, and remove the bearing and support assembly.



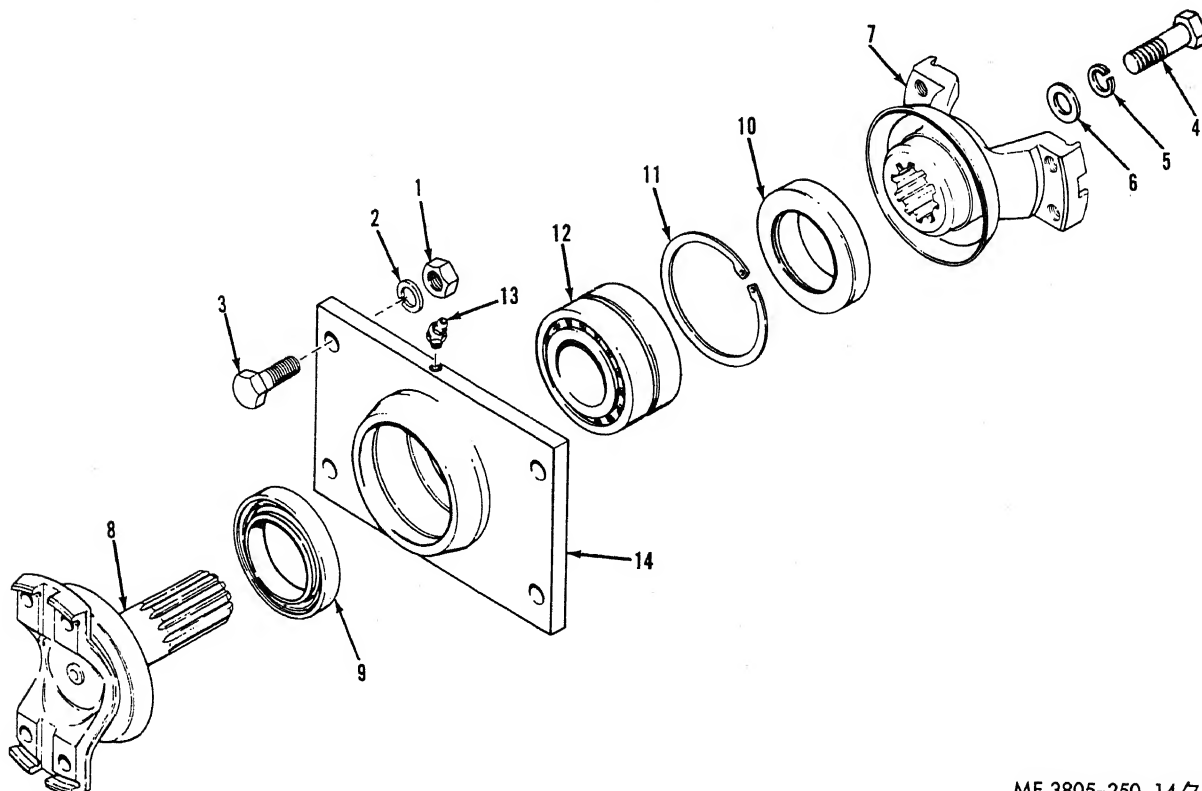
*Figure 7-15. Center bearing and support removal and installation.*

(3) Remove bolt (4), lockwasher (5) and flat washer (6) which secure flange (7) to flange (8). Pull flange (8) from flange (7).

(4) Carefully pull the oil seals (9) and (10) from their bores. Discard seals.

(5) Remove retaining ring (11) and press bearing (12) from the support (14).

(6) Remove fitting (13).



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- |                 |                    |
|-----------------|--------------------|
| 1. Nut          | 8. Rear flange     |
| 2. Lockwasher   | 9. Oil seal        |
| 3. Bolt         | 10. Oil seal       |
| 4. Bolt         | 11. Retaining ring |
| 5. Lockwasher   | 12. Bearing        |
| 6. Flat washer  | 13. Fitting        |
| 7. Front flange | 14. Support        |

Figure 7-16. Center bearing and support, exploded view.

**b. Cleaning, Inspection and Repair.**

(1) Clean all parts thoroughly with solvent and dry with compressed air, except for the center bearing. Allow the bearing to air dry after thoroughly flushing with solvent.

(2) Inspect the front and rear flanges for cracks, burrs, twisted or broken splines and other damage. Remove burrs with a soft stone or crocus cloth. Replace flanges if they are badly damaged.

(3) Inspect the center support for cracks and other damage. Replace the support if needed.

(4) Inspect the bearing for nicks, scratches, scoring, pitting, and flat spots. Replace bearing if damaged.

**c. Reassembly and Installation.** Refer to figure 7-16.

(1) Pack bearing (12) with grease and install it in the support (14). Install retaining ring (11) making sure it seats in its groove.

(2) Install new grease seals (9 and 10) in the support.

(3) Slide the rear flange (8) into the support, and engage the spline with the front flange (7). The flange faces must be assembled at right angles to each other. Install flat washer (6), lockwasher (5) and bolt (4) in the flange. With the rear yoke held securely in a vise, tighten bolt (4) to  $350 \pm 10$  pound-feet.

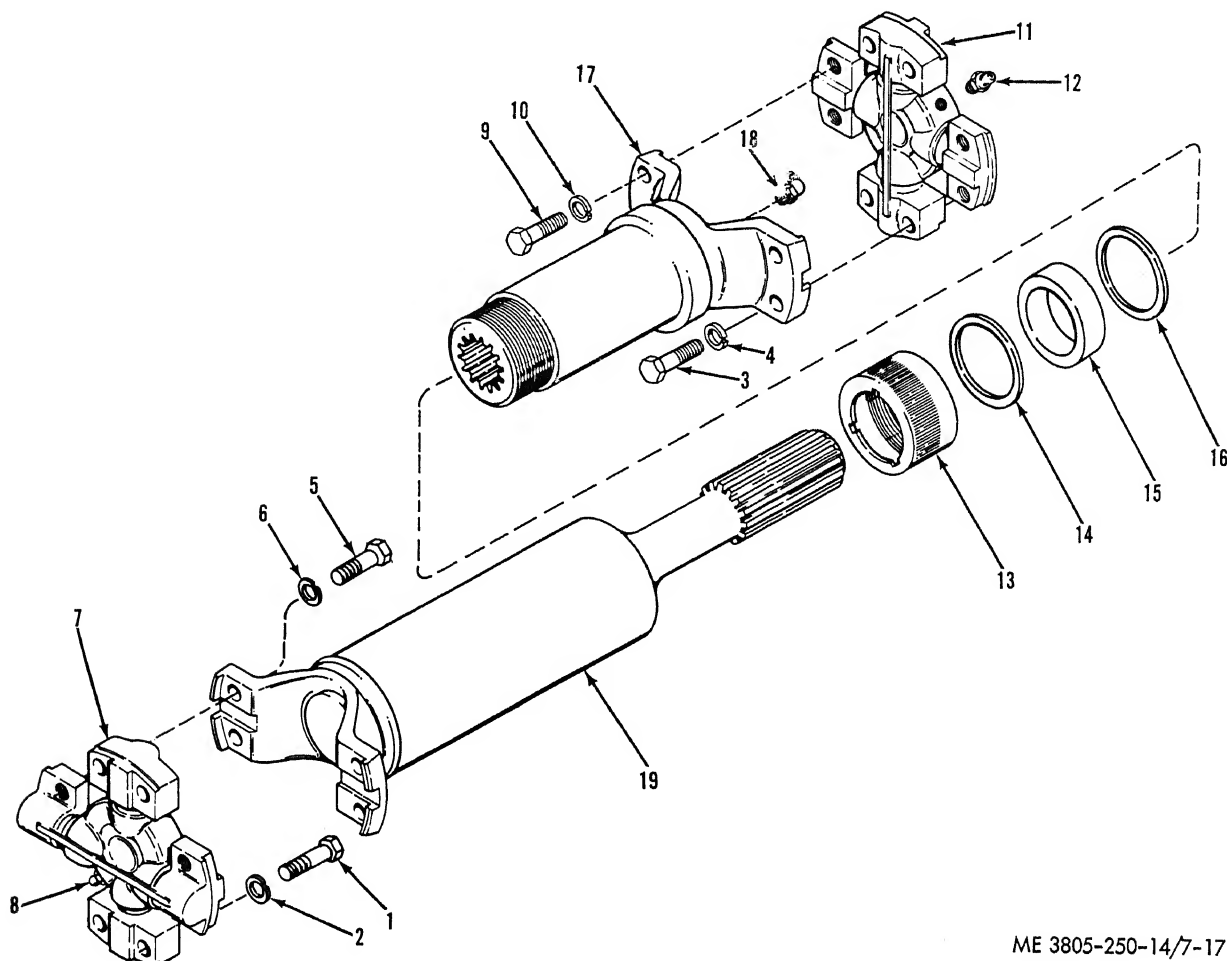
(4) Install fitting (13).

(5) Position the center bearing support on the front chassis and secure with bolts (3), lockwashers (2) and nuts (1).

(6) Connect the intermediate and front propeller shafts to the center bearing flanges, tightening the bolts to  $35 \pm 5$  pound-feet.

**7-9. Intermediate Propeller Shaft**

Repair of the intermediate propeller shaft is similar to repair of the front propeller shaft. Refer to paragraph 7-7 for repair instructions and to figure 7-17 for an exploded view of the intermediate propeller shaft.



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1. Bolt
2. Lockwasher
3. Bolt
4. Lockwasher
5. Bolt
6. Lockwasher
7. Spider and bearing assembly
8. Fitting
9. Bolt
11. Lockwasher

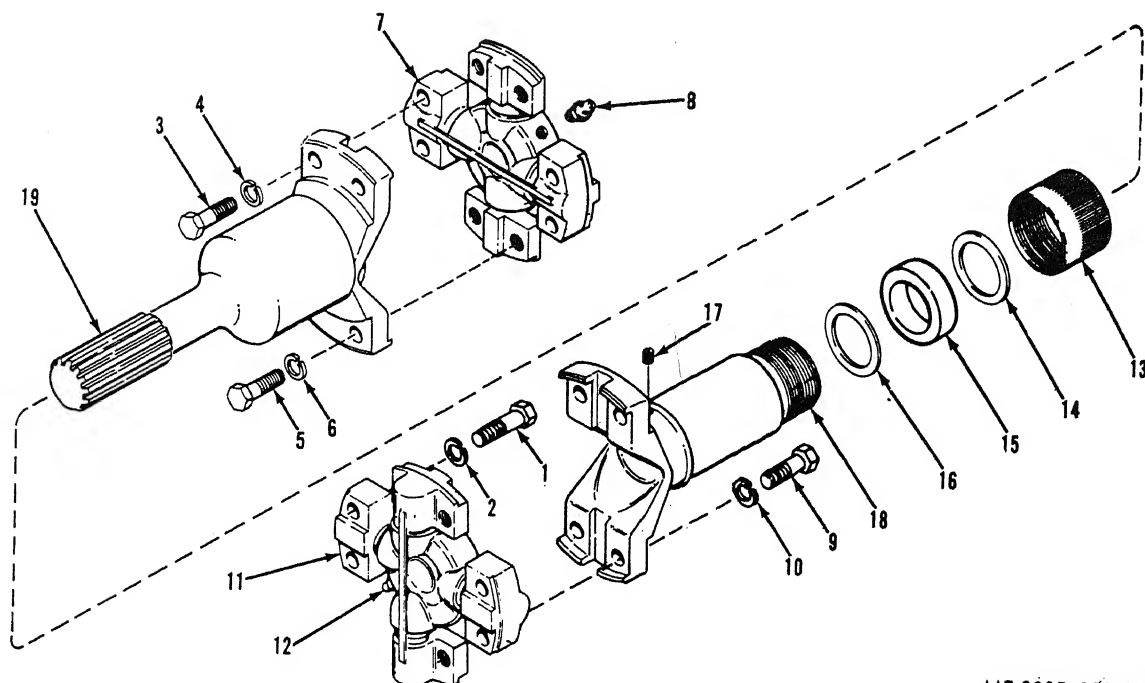
11. Spider and bearing assembly
12. Fitting
13. Retaining nut
14. Retaining washer
15. Felt washer
16. Retaining washer
17. Plug
18. Slip yoke
19. Propeller shaft

Figure 7-17. Intermediate propeller shaft, exploded view.

### 7-10. Rear Propeller Shaft

Repair of the rear propeller shaft is similar to repair of the front propeller shaft. Refer to

paragraph 7-7 for repair instructions and to figure 7-18 for an exploded view of the rear propeller shaft.



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1. Bolt
2. Lockwasher
3. Bolt
4. Lockwasher
5. Bolt
6. Lockwasher
7. Spider and bearing assembly
8. Fitting
9. Bolt
10. Lockwasher

11. Spider and bearing assembly
12. Fitting
13. Retaining nut
14. Retaining washer
15. Felt washer
16. Retaining washer
17. Plug
18. Slip yoke
19. Propeller shaft

Figure 7-18. Rear propeller shaft, exploded view.

### Section III. FRONT AXLE ASSEMBLY

#### 7-11. General

The front axle assembly is rigidly attached to the front chassis. It contains the vehicle parking brake, a differential, final planetary drives and the axle shafts. Refer to paragraph 5-8 for axle assembly removal and installation.

#### 7-12. Axle Shaft

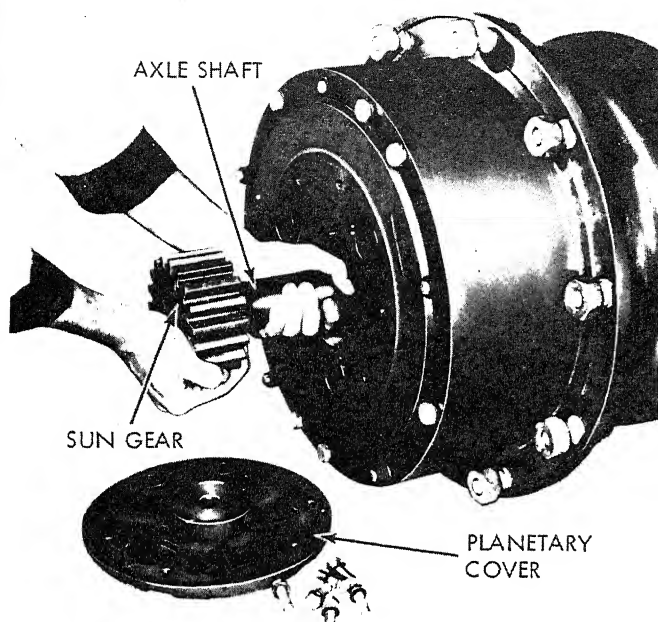
##### a. Removal.

(1) Drain the oil from the planetary drive hub. Refer to paragraph 4-41.

(2) Remove six bolts and lockwashers securing the planetary cover to the planetary spider assembly.

(3) Pull the planetary sun gear and axle shaft from the axle housing, figure 7-19.





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Figure 7-19. Planetary sun gear and axle removal.

(4) Remove the retaining ring from the sun gear, and separate the gear from the shaft.

**b. Cleaning, Inspection and Repair.**

(1) Clean the axle shaft and sun gear thoroughly with solvent, and dry with compressed air.

(2) Inspect the sun gear teeth and axle shaft splines for cracks, chipping, burrs, twisted splines and other damage, and wear. Perform a magnetic particle inspection of the shaft. Remove burrs from gear teeth and splines with a soft stone or crocus cloth. Replace damaged sun gear. Replace a fatigued, cracked, twisted or bent axle shaft.

(3) Inspect the planetary cover for cracks and other damage. Check thrust washer in the cover for damage and wear. Replace thrust washer if damaged or excessively worn. Replace damaged cover.

**c. Installation.**

(1) Assemble the sun gear, retaining ring and axle shaft.

(2) Insert the axle shaft into the housing, and carefully slide it in until the splined end of the shaft engages the differential.

(3) Coat the planetary cover mounting surface with a sealant and install the cover and its hardware. Tighten the bolts to 50 to 55 pound-feet.

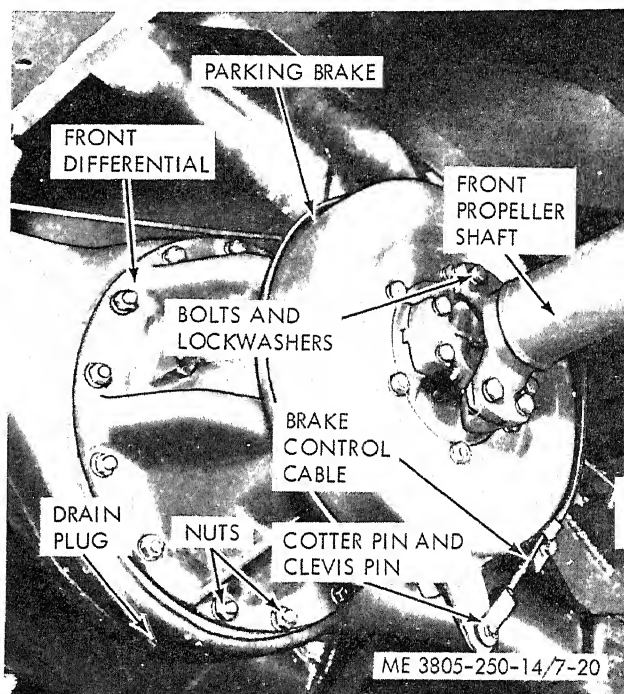
(4) Fill the planetary drive hub with oil as specified in the Lubrication Order.

**7-13. Differential**

**a. Removal.**

(1) Drain the oil from the axle housing (para 4-41).

(2) Refer to figure 7-20, and remove the cotter pin and clevis pin securing the brake control cable to the parking brake.



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Figure 7-20. Front differential removal and installation.

(3) Remove bolts and lockwashers and disconnect the front propeller shaft.

(4) Remove the axle shafts from the axle housing as described in paragraph 7-12.

(5) Attach a companion flange retaining tool to the flange as shown in figure 7-21. Remove the companion flange cotter pin and nut.

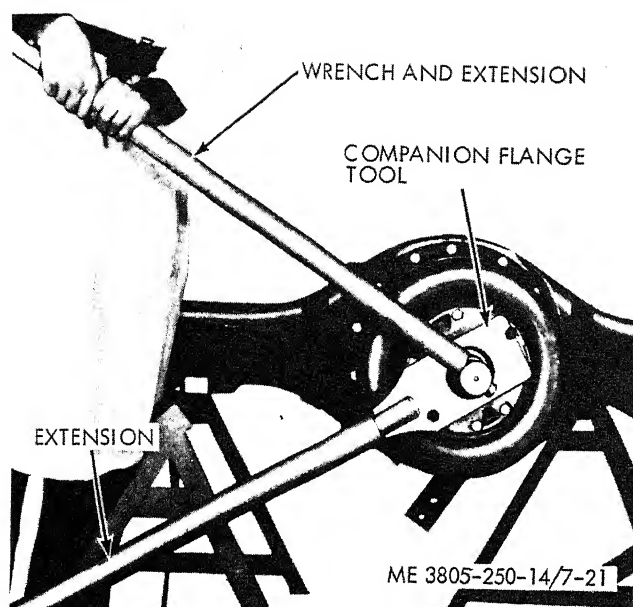


Figure 7-21. Companion flange removal.

(6) Attach a suitable puller to the companion flange and pull the flange and parking brake drum from the differential. Remove the six bolts, nuts, and lockwashers securing the brake drum to the companion flange.

(7) Remove the parking brake shoe return springs, brake shoes, operating cam, brake actuating roller, and backing plate. Refer to paragraph 7-20 for removal procedures.

(8) Temporarily install the companion flange and nut to facilitate handling.

**CAUTION:** The differential assembly must be adequately supported at removal to prevent it from falling and causing damage or serious personal injury.

(9) Support the weight of the differential and remove the attaching nuts and lockwashers, figure 7-20. Use a soft hammer to tap the differential carrier to break the seal with the axle house.

*b. Disassembly.* Refer to figure 7-22.

(1) Position the differential in a differential overhaul stand.

(2) Check and record the ring gear backlash with a dial indicator. This information is necessary for reassembly, unless a new gear set is installed.

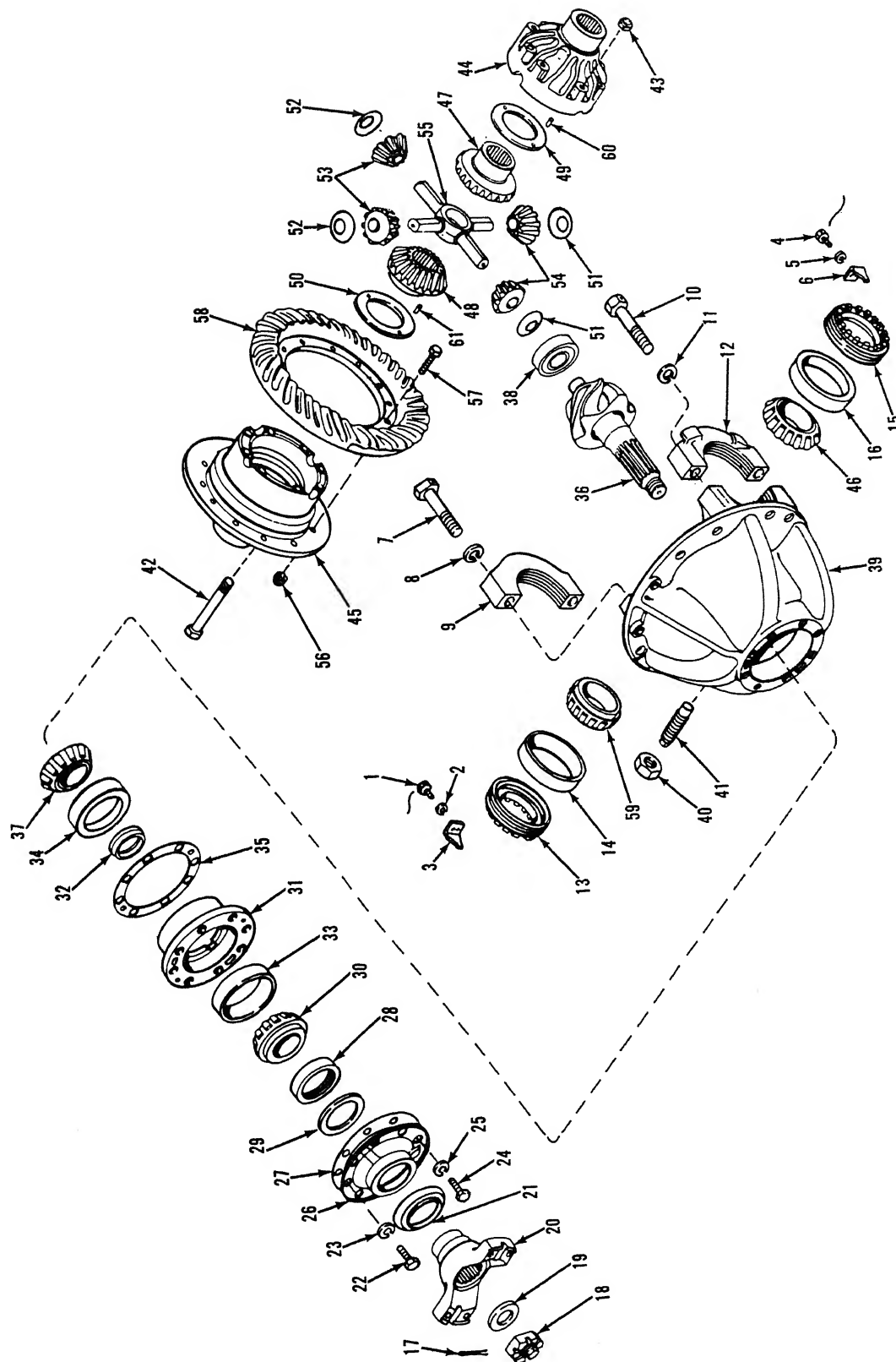
(3) Match mark the differential bearing caps to the carrier to ensure correct reassembly.

(4) Remove and discard all lock wires.

(5) Remove capscrew (1), lockwasher (2), and adjusting nut retainer lock (3). Remove opposite side capscrew (4), lockwasher (5) and adjusting nut retainer lock (6).

**KEY to fig. 7-22:**

1. Capscrew
2. Lockwasher
3. Retainer lock
4. Capscrew
5. Lockwasher
6. Retainer lock
7. Bolt
8. Washer
9. Bearing cap
10. Bolt
11. Washer
12. Bearing cap
13. Adjusting nut
14. Bearing cap
15. Adjusting nut
16. Bearing cap
17. Cotter pin
18. Nut
19. Washer
20. Flange
21. Dust shield
22. Capscrew
23. Lockwasher
24. Bolt
25. Lockwasher
26. Seal retainer
27. Gasket
28. Seal
29. Gasket
30. Bearing cone
31. Bearing cage
32. Spacer and shims
33. Bearing cup
34. Bearing cup
35. Shim
36. Pinion
37. Bearing cone
38. Bearing
39. Differential carrier
40. Thrust screw nut
41. Thrust screw
42. Bolt
43. Nut
44. Case half
45. Case half
46. Bearing cone
47. Side gear
48. Side gear
49. Thrust washer
50. Thrust washer
51. Thrust washer
52. Thrust washer
53. Pinion
54. Pinion
55. Differential spider
56. Nuts
57. Bolts
58. Ring gear
59. Bearing cone
60. Dowel pin
61. Dowel pin



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Figure 7-22. Differential, exploded view.

(6) Remove bolts (7), flat washers (8) and bearing cap (9). Remove opposite side bolts (10), flat washers (11) and bearing cap (12).

(7) Insert a bar through the differential, raise one end of the bar, and remove adjusting nut (13) and bearing cup (14). Remove opposite side adjusting nut (15) and bearing cup (16).

(8) Hoist the differential unit from the carrier assembly. Tilt the differential slightly so the ring gear will clear the pinion shaft inner bearing boss in the carrier.

(9) Remove cotter pin (17). Remove companion flange nut (18), washer (19) and companion flange (20). Use an appropriate puller to remove the flange if needed. Remove dust shield (21).

(10) Remove pinion cage locating capscrew (22) and lockwasher (23). Remove bolts (24), lockwashers (25) and oil seal retainer (26). Use a soft mallet to break the retainer loose if necessary. Remove and discard gasket (27). Drive oil seal (28) from oil seal retainer (26). Remove and discard oil seal gasket (29).

(11) Install two  $\frac{3}{8}$ -16 NC bolts in the bearing cage puller holes. Turn each bolt equally to prevent damage to the carrier, shaft, or bearings. When bearing cage (31) has moved out a short distance, insert 0.030 inch shim stock at the puller bolts to prevent possible damage to the cage shim pack.

(12) Remove outer pinion bearing cone (30), bearing cage (31) and spacer and shims (32). Drive bearing cups (33) and (34) from bearing cage (31). Remove and retain shims (35).

(13) Press the shaft of pinion (36) with center bearing cone (37) and bearing (38) from the differential carrier (39).

(14) Remove differential thrust screw nut (40), and thrust screw (41) from the carrier (39).

(15) Match mark the differential case halves (44 and 45), to ensure correct reassembly. Remove bolts (42) and nuts (43) holding the case halves (44) and (45) together. Use a soft mallet if necessary to separate the case halves. Lift case half (44) and bearing cone (46) from case half (45). Pull bearing cone (46) from case half (44).

(16) Remove side gears (47 and 48), side gear thrust washers (49 and 50), pinion thrust washers (51 and 52), and pinions (53 and 54) from differential spider (55).

(17) Remove nuts (56) and bolts (57) securing ring gear (58) to case half (45). Pull bearing cone (59) from case half (45).

#### c. Cleaning, Inspection and Repair.

(1) Clean all parts thoroughly with solvent, and dry with compressed air. Do not use com-

pressed air to dry the bearings. Flush the bearings thoroughly with solvent and allow to air dry.

(2) Inspect all gears and splines for nicks, cracked, broken, scored or worn teeth. Remove burrs from gear teeth and splines with a soft honing stone or crocus cloth. Replace badly damaged or worn gears.

*Note.* The differential pinions (53 and 54, fig. 2) and side gears (47 and 48) must be replaced as a set, as the ring gear (58) and pinion (36).

(3) Inspect the differential carrier, case halves, bearing cage, spider, and seal retainer for cracks, burrs, and damage to machined surfaces. Remove burrs and minor surface irregularities with a soft honing stone or crocus cloth. Replace a cracked or badly damaged part.

*Note.* The differential case halves must be replaced as a set.

(4) Inspect the bearing cups and cone for nicks, scratches, burrs, scoring, pitting, and wear. Replace damaged bearings.

(5) Inspect the companion flange for cracks, burrs, twisted splines and other damage. Remove burrs with a soft honing stone or crocus cloth. Replace flange if cracked or if splines are twisted.

(6) Inspect side gears and pinion thrust washers and differential thrust screw for damage and wear. Replace damaged or excessively worn thrust washers.

#### d. Reassembly. Refer to figure 7-22.

(1) Fabricate the bearing driver shown in figure 5-8 and press inner pinion bearing (38) on the pinion (36). Stake the pinion shaft in equally spaced places to retain the bearing.

(2) Press the center pinion bearing cone (37) onto the pinion (36).

(3) Install a spacer (32) and a 0.010 inch thick shim on the pinion. The shims are part of the differential and carrier repair kit.

(4) Press bearing cups (33 and 34) into the bearing cage (31), using locally-fabricated drivers shown in figures 5-6 and 5-7. Position the bearing cage assembly on the pinion shaft, and press the bearing cone (30) onto the pinion using locally-fabricated drivers shown in figure 5-5.

(5) Check bearing preload while maintaining pressure at 500 pounds on the outer bearing cone. Wrap several turns of soft wire or cord around the bearing cage (31). Attach a spring scale to the wire or cord and pull in a straight line 90 degrees from the shaft center line. Read the scale and measure the rotating torque. Multiply the reading on the scale by one-half of the bearing diameter to obtain bearing preload. Correct preload torque is  $18 \pm 5$  pound-inches. If preload is too

within these limits, remove shims to increase the preload, or add shims to decrease preload.

*Note.* This bearing preload check is preliminary only. Final preload check is made with pinion and bearing assembly in the differential carrier.

(6) Press bearing cone (46) into case half (44) and bearing cone (59) on case half (45). Use locally-fabricated driver shown in figure 5-4.

(7) Install ring gear (58) on case half (45) and secure with bolts (57) and nuts (56). Insert bolts from tooth side so the inner diameter of the ring gear retains the bolt heads. Tighten the nuts to 171 to 188 pound-feet.

(8) Install thrust washer (50) and side gear (48) in case half (45). Make sure the hole in the thrust washer engages the dowel pin in the case half.

(9) Install the pinions (53 and 54) and thrust washers (51 and 52) on the spider (55). Install side gear (47) and thrust washer (49) on the spider assembly, position the spider assembly in case half (45), and place case half (44) on the assembly. Align the match marks, and make sure the hole in the thrust washer (49) engages the dowel pin in case half (44). Install bolts (42) and nuts (43), tightening the nuts to 171 to 188 pound-feet.

(10) Install pinion and cage assembly, and bearing cage shims (35) on the carrier (39). Use original shim pack or equivalent thickness. Use oil seal retainer bolts (24) to pull the cage into position. Make sure all oil passages are aligned at assembly.

(11) Temporarily install the companion flange (20) and nut (18) and tighten the nut to 500 pound-feet. Using an inch pound torque wrench, check bearing preload. Correct preload is  $18 \pm 5$  pound-inches. If torque does not fall within these limits, disassemble the unit and add bearing cage shims to decrease preload, or remove shims to increase preload. When correct preload is obtained, remove the seal retainer bolts and the companion flange.

(12) Coat the outer circumference of seal (28) with a nonhardening sealer, install gasket (29) in the seal retainer (26), and press the seal into the retainer, so the seal lip will be towards the pinion. Install new gasket (27) and retainer locating

capscrew (22). Tighten capscrew to 57 to 63 pound-feet. Install lockwasher (23) and position the seal retainer on the bearing cage. Install the eleven retainer bolts (24) and lockwashers (25). Tighten the bolts to  $86 \pm 4$  pound-feet.

(13) Install companion flange (20) flat washer (19) and nut (18) on the pinion. Tighten the nut fingertight.

(14) Position differential carrier to accept the differential assembly. Insert a bar through the differential and position the differential in the carrier.

(15) Position bearing cup (16) and adjusting nut (15) on the lifting bar and raise the bar so the cup and nut can be installed on the differential. In like manner, install bearing cup (14) and adjusting nut (13). Be careful not to cross thread the adjusting nuts.

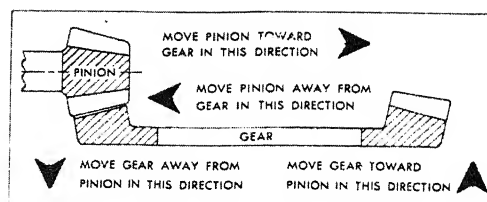
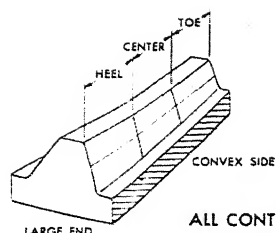
(16) Install bearing cap (12) with bolts (10) and washers (11), aligning match marks on the cap and carrier. In like manner install bearing cap (9), bolts (7) and washers (8). Tighten bolts snugly, but do not torque them down.

(17) Tighten the bearing adjusting nuts (13 and 15) to adjust the bearings to zero end play. End play can be checked by prying against the bearing and differential case with a screwdriver.

(18) Check the ring gear and pinion backlash with a dial indicator. If old ring gear and pinion were installed, check for backlash noted at time of disassembly. If new gear set was installed, backlash must be  $0.011 \pm 0.002$  inch. Adjust backlash by alternately loosening and tightening the opposing nuts.

*Note.* When loosening one adjusting nut and tightening the other adjusting nut, be sure to move each nut the same distance to maintain bearing end play adjustment.

(19) Check the ring gear and pinion for proper tooth contact. Paint the ring gear teeth with a mixture of red lead and linseed oil. Rotate the ring gear through one complete revolution in each direction, and compare the tooth contact pattern against figure 7-23. Adjust backlash, or pinion bearing cage shim pack to move the ring gear or pinion as needed to obtain the correct tooth contact pattern.



ALL CONTACT BEARINGS SHOWN BELOW ARE ON RIGHT HAND SPIRAL RING GEAR — THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.



#### CONDITION 1

TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD



#### CONDITION 2

TOE BEARING ON BOTH SIDES OF TOOTH — GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.



#### CONDITION 3

HEEL BEARING ON BOTH SIDES OF TOOTH — GEAR SET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.



#### CONDITION 4

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR. INCREASE MOUNTING DISTANCE BY ADDING SHIMS BETWEEN BEARING CAGE AND DIFFERENTIAL HOUSING.



#### CONDITION 5

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR. DECREASE MOUNTING DISTANCE BY REMOVING SHIMS FROM BETWEEN BEARING CAGE AND DIFFERENTIAL HOUSING.



#### BACKLASH

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL.

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Figure 7-23. Tooth bearing contact chart.

(20) Tighten the bearing cap bolts (7 and 10) to  $311 \pm 15$  pound-feet, and recheck ring gear and pinion backlash and bearing end play.

(21) Check the run out of the back face of the ring gear with a dial indicator. Runout must not exceed 0.005 inch. If runout is excessive, remove and disassemble the differential and check for dirt or burrs under the gear mounting surface. Reassemble the differential, and recheck clearances.

(22) Install retainer locks (3 and 6), lock-washers (2 and 5), and capscrews (1 and 4).

Tighten the capscrews to 30 to 35 pound-feet and lock wire the capscrews to the bearing cap 1 ts.

(23) Install differential thrust screw 1), turning it in until it just contacts the back o he ring gear. Back the screw off  $\frac{1}{4}$  turn (0.010 h) and secure with thrust screw nut (40). Tighten he nut to 300 pound-feet.

e. Installation. Refer to figure 7-20.

(1) Apply a coating of sealer to the le housing face. Align the mounting holes in he differential carrier with the studs in the le

housing, and install the differential assembly. Install nuts, tapered dowels, and lockwashers, tightening the nuts to  $80 \pm 5$  pound-feet.

(2) Remove the temporarily installed companion flange (20), nut (18), and flat washer (19) from the differential assembly.

(3) Install the parking brake backing plate on the differential and secure with four bolts. Refer to paragraph 7-20 for parking brake assembly and installation.

(4) Position the parking brake drum on the companion flange and install bolts, lockwashers and nuts.

(5) Position the brake drum and companion flange on the differential, and install flat washer and nut. Attach the companion flange tool and tighten the nut to 500 pound-feet. Secure the nut with the cotter pin, and remove companion flange tool.

(6) Attach the parking brake control cable to the brake assembly with the clevis pin and cotter pin.

(7) Connect the front propeller shaft to the companion flange with bolts and lockwashers. Tighten the bolts to  $29 \pm 3$  pound-feet.

(8) Install the axle shafts in the axle housing as described in paragraph 7-12.

(9) Fill differential and axle housing with oil as specified in the Lubrication Order.

#### 7-14. Planetary Drive and Axle Housing

*Note.* Instructions are based on removal of components on one end of the axle but apply equally to both ends.

##### a. Removal.

(1) Refer to paragraph 5-7 and remove the planetary drive and axle housing from the vehicle.

(2) Place the assembly on steel horses, with the mounting pads on the flat surface of the horses.

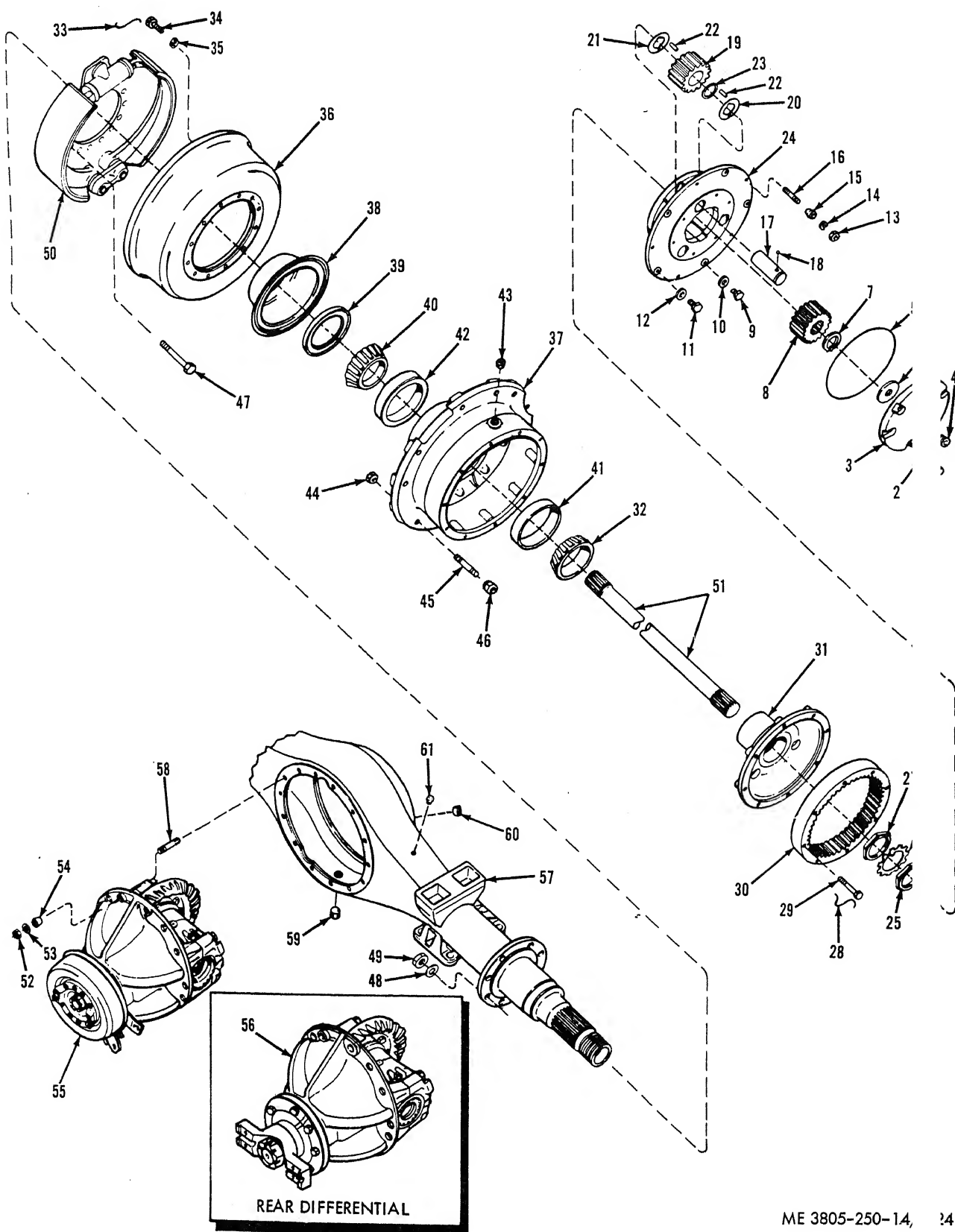
##### b. Disassembly. Refer to figure 7-24.

(1) Remove bolts (1), and lockwashers (2), and remove planetary cover (3). Remove plug (4) and seal (5) from the cover and separate the cover and sun gear thrust washer (6).

#### KEY to fig. 7-24:

1. Bolt
2. Lockwasher
3. Planetary cover
4. Plug
5. Seal
6. Thrust washer
7. Retaining ring
8. Sun gear
9. Capscrew
10. Lockwasher
11. Bolt
12. Lockwasher
13. Nut
14. Lockwasher
15. Tapered dowel
16. Stud
17. Pin
18. Ball
19. Pinion
20. Thrust washer
21. Thrust washer
22. Roller
23. Spacer
24. Carrier
25. Outer spindle nut
26. Lockwasher
27. Inner spindle nut
28. Lockwire
29. Bolt
30. Ring gear
31. Hub
32. Bearing cone
33. Lockwire
34. Bolt
35. Washer
36. Brake drum
37. Wheel hub
38. Oil catcher
39. Seal
40. Bearing cone
41. Bearing cup
42. Bearing cup
43. Plug
44. Nut
45. Stud
46. Nut
47. Bolt
48. Lockwasher
49. Nut
50. Brake assembly
51. Axle shaft
52. Nut
53. Washer
54. Tapered dowel
55. Front differential and carrier assembly
56. Rear differential and carrier assembly
57. Axle housing
58. Dowel
59. Plug
60. Plug
61. Breather





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Figure 7-24. Planetary drive and axle housing exploded view.



(2) Remove retaining ring (7) and slide the sun gear (8) from the planetary carrier assembly.

(3) Remove two capscrews (9) and two lockwashers (10) from the carrier. Remove five bolts (11), five lockwashers (12), five nuts (13), five lockwashers (14) and five tapered dowels (15) securing the carrier to the hub. Remove studs (16) only if replacement is needed. Install two forcing bolts in the holes from which bolts (9) were removed, and force the carrier assembly from the hub.

(4) Press the planetary pins (17) with their retaining balls (18) from the planetary carrier. Remove the three planet pinions (19), thrust washers (20 and 21), pinion rollers (22) and pinion roller spacer (23) from the carrier (24).

(5) Straighten the tangs on lockwasher (26). Wrap several turns of shim stock around the axle shaft. Fabricate the special spindle nut socket (fig. 5-11) and install on the out side spindle nut (25) as shown in figure 7-25. Lightly tighten the guide bolts.

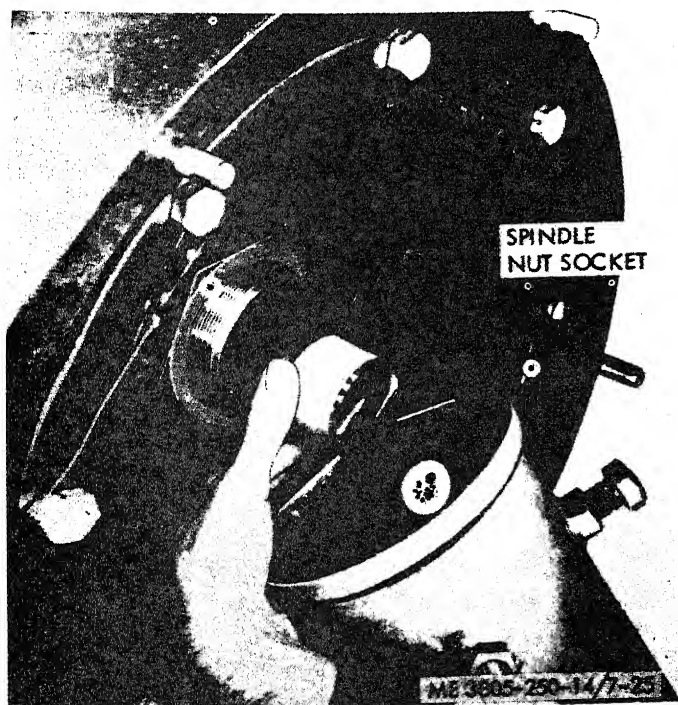


Figure 7-25. Spindle nut removal.

(6) Remove the outer spindle nut (25, fig. 7-24), lockwasher (26) and inner spindle nut (27).

(7) Support the weight of the brake drum and hub assembly with a hoist, and remove the internal gear and hub assembly.

(8) Remove and discard lockwire (28), and remove bolts (29) securing ring gear (30) to hub (31). Pull bearing cone (32) from hub (31).

(9) Pull the brake drum and hub assembly from the axle housing. Remove and discard lockwire (33), and remove bolts (34) and washers (35) securing the brake drum (36) to the wheel hub (37). Remove oil catcher (38).

(10) Pry oil seal (39) from the wheel hub (37), and lift out bearing cone (40). Drive bearing cups (41 and 42) from the wheel hub. Remove nuts (44) and studs (45) from the hub. Nuts (46) were previously removed when the wheels were removed.

(11) Remove bolts (47), lockwashers (48), and nuts (49) securing the brake assembly (50) to the axle housing. Slide axle shaft (51) out of the housing.

(12) Remove nuts (52), washers (53) and tapered dowels (54) securing front differential and carrier assembly (55) or rear differential and carrier assembly (56) to the axle housing (57). Remove studs (58), plug (60) and breather (61) from the housing only if replacement is necessary.

*Note.* Plugs (43 and 59) were removed when the differential was removed (para 7-13).

#### *c. Cleaning, Inspection and Repair.*

(1) Clean all parts thoroughly with solvent and dry with compressed air. Do not use compressed air to dry the bearings. Flush the bearings thoroughly with solvent and allow them to air dry.

(2) Inspect the axle housing for cracks, fatigue lines, and damage to the machined surfaces. Repair cracks by welding. Build up and remachine finished surfaces if needed. Remove burrs and minor surface damage with a suitable honing stone or emery cloth. Replace a badly damaged axle housing.

(3) Inspect the brake drum for cracks, scoring, roughness and other damage. Turn down scored or rough drum on a lathe. Do not remove more metal than is necessary to smooth the braking surface. The maximum allowable inside diameter of the drum is 17.37 inches. Replace drum if cracked or if inside diameter of the drum cannot be cleaned up by machining.

(4) Inspect the planetary carrier, internal hub, and wheel hub, for cracks and damage to machined surfaces. Repair cracks by welding and remachining, if feasible. Remove burrs and other minor surface damage with a suitable honing stone or emery cloth. Replace badly damaged parts.

(5) Inspect the planetary pinions, internal gear, sun gear, and the axle shaft for nicks, cracks, chipped, scored, broken, or excessively worn teeth, and other damage. Perform a magnetic particle inspection on these parts. Remove burrs with a suitable honing stone. Replace badly worn or damaged parts.

(6) Inspect the bearing cups and cones for nicks, scratches, scoring, pitting, and flat spots. Replace bearing cones and cups if either is damaged.

(7) Inspect the planetary pins and rollers for nicks, scratches, scoring, and wear. Replace the pins or rollers if damaged.

(8) Inspect the pinion thrust washers and the sun gear thrust washer for damage and wear. Replace excessively worn thrust washers.

*d. Reassembly.* Refer to figure 7-24.

(1) Refer to paragraph 7-13 and install the rear differential and carrier assembly (56) or front differential and carrier assembly (55) on the axle housing (57). Use a hoist to position the differential on the housing. Install tapered dowels (54), washers (53) and nuts (52), and tighten nuts to 75 to 85 pound-feet.

(2) Slide the axle shaft (51) into the housing and engage the splines of the differential side gears.

(3) Install the wheel brake assembly (50) and secure with bolts (47), nuts (49) and lockwashers (48). Tighten the nuts to 120 to 130 pound-feet.

(4) Press bearing cups (41 and 42) in the wheel hub (37) with locally-fabricated bearing driver (fig. 5-2) to seat the cups. Lubricate bearing cone (40 fig. 7-24) with gear oil, and install it in bearing cup (42).

(5) Coat the outer surface of oil seal (39) with sealant and press the seal into the wheel hub using locally-fabricated seal driver (fig. 5-9). The seal lip faces inward. Position the oil catcher (38 fig. 7-24) and brake drum (36) on the wheel hub, and install bolts (34) and flat washers (35). Tighten the bolts to  $167 \pm 8$  pound-feet. Install lockwire (33) to retain bolts. Install the drum and hub assembly on the axle housing, and support it with a hoist.

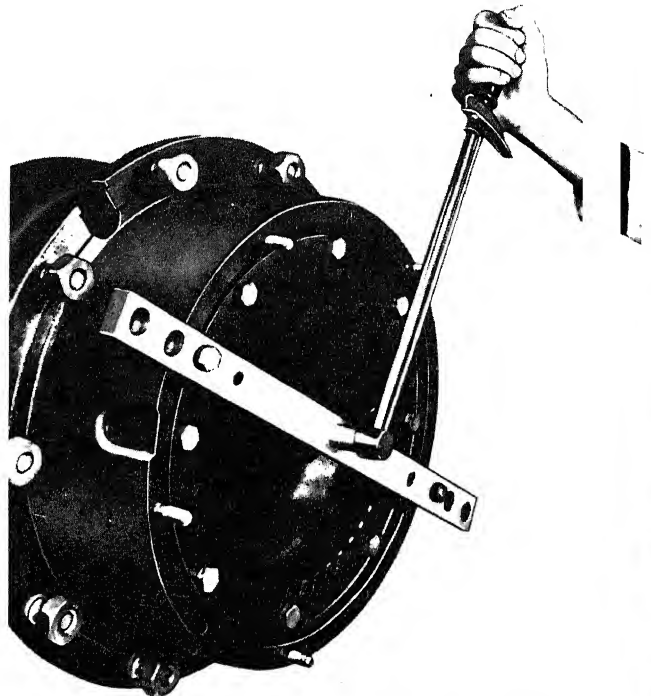
(6) Using locally-fabricated bearing driver shown in figure 5-3, press bearing cone (32 fig. 7-24) onto the internal gear hub (31). Position the ring gear (30) on the hub (31) and install bolts (29). Tighten bolts to  $110 \pm 5$  pound-feet and secure with lockwire (28). Install the hub and ring gear assembly on the axle, engaging the splines in the hub with the splines on the axle housing.

(7) Install inner spindle nut (27) on the spindle. Wrap several turns of shim stock around the axle shaft, and install spindle nut socket (fig. 5-11). Tighten the guide screws. Tighten the nut while rotating the wheel hub in both directions until there is a slight binding.

**CAUTION:** When checking rotating torque, ensure that the brakes do not contact the drum. Erroneous torque values will result.

(8) Fabricate a torque wrench adapter bar

(fig. 5-10) and check the rotating torque as in figure 7-26. Rotating torque, with new bearings, should be 15 to 20 pound-feet and with old bearings, 6 to 12 pound-feet. If rotating torque does not fall within limits, remove the torque wrench adapter bar and loosen or tighten spindle nut and recheck torque until the proper value is obtained. After tightening or loosening the nut, strike the hub sharply several times to seat the bearings, and recheck torque.



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Figure 7-26. Checking rotating torque.

(9) Install lockwasher (26 fig. 7-24) and spindle nut (25), and tighten to secure the inner nut. Bend two tangs of the lockwasher against flats of the inner nut, and two tangs against the flats of the outer nuts.

(10) Coat the inside of the planet pinions with grease and install two rows of rollers (22) separating them with spacer (23). Position pinion in the carrier (24) with thrust washers (20 and 21). Make sure the tangs on the thrust washers engage the grooves in the carrier. Press in pinion pins (17) making sure the ball recess is aligned with the groove in the carrier. Insert ball (18) and complete the press. Pins must be filed with the face of the carrier. Stake the ball groove in two places to retain the ball.

(11) Apply a light coating of sealant to the mounting flange of the planetary carrier (24) and

install the carrier on the hub (37). Install bolts (11) and lockwashers (12), nuts (13), lockwashers (14) and tapered dowels (15). Tighten the bolts and nuts to 85 to 95 pound-feet.

(12) Install sun gear (8) and secure with retaining ring (7).

(13) Install seal (5) on planetary cover (3) and install thrust washer (6). Apply a coating of sealant to the cover mounting surface and install

cover. Secure with bolts (1) and lockwashers (2). Tighten the bolts to 75 to 85 pound-feet.

(14) Adjust brakes as described in paragraph 4-43.

*e. Installation.*

(1) Install the front axle assembly as described in paragraph 5-8.

(2) Install the wheels and tires as described in paragraph 7-26.

## Section IV. REAR AXLE ASSEMBLY

### 7-15. General

The rear axle assembly is trunnion mounted to the rear chassis. The trunnion mount makes it possible to maintain maximum tractive effort in rugged terrain. The rear axle assembly contains a differential unit, final planetary drives and the axle shafts. Refer to paragraph 5-8 for rear axle removal.

### 7-16. Axle Shaft

Refer to paragraph 7-12 for axle shaft removal and disassembly procedures.

### 7-17. Differential

Refer to paragraph 7-13 for differential removal and disassembly procedures.

*Note.* The instructions in paragraph 7-13 refer to front differential removal and disassembly. After the parking brake is removed, however, the front and rear differential units are identical.

### 7-18. Planetary Drive and Axle Housing

Refer to paragraph 7-14 for planetary drive and axle housing removal and disassembly.

*Note.* With the exception of the parking brake on the front differential unit, the front and rear axles are the same.

## Section V. BRAKES

### 7-19. General

*a.* The loader brakes consist of a parking brake and a wheel brake system.

*b.* The parking brake is mounted on the front wheels and is manually operated.

*c.* The wheel brakes operate by compressed air over hydraulic brake fluid. When the brake treadle is depressed, the brake air valve opens to control the flow of compressed air to the front and rear brake actuators. The brake actuator consists of an air chamber and a hydraulic cylinder. Compressed air acts on the piston and push rod in the air chamber, forcing the push rod against the piston in the hydraulic cylinder and increasing the pressure in the hydraulic brake system. As the pressure increases, the pistons in the wheel cylinder move outward, forcing the brake shoes against the brake drums. Brake shoe pressure is proportional to the amount of air delivered by the treadle valve.

*d.* Refer to figure 1-5 for an air system schematic diagram.

### 7-20. Parking Brake

*a. Removal and Disassembly.*

(1) Park the loader on firm level ground and block the wheels.

(2) Disconnect the front drive shaft from the parking brake yoke.

(3) Remove six brake drum mounting nuts (1, fig. 7-27), bolts (2) and washers (3), and remove the brake drum (4).

*Note.* Do not remove the pinion flange (8) unless the actuator lever (12) or the backing plate (15) must be removed.

(4) Remove the pinion flange (8) as follows:

(a) Remove cotter key (5) from pinion nut (6). Mark the nut and pinion shaft for correct reassembly.

(b) Prevent the pinion flange (8) from turning, and loosen nut (6). Tighten the nut with a torque wrench until the alignment marks line up. Record the torque reading for use during reassembly.

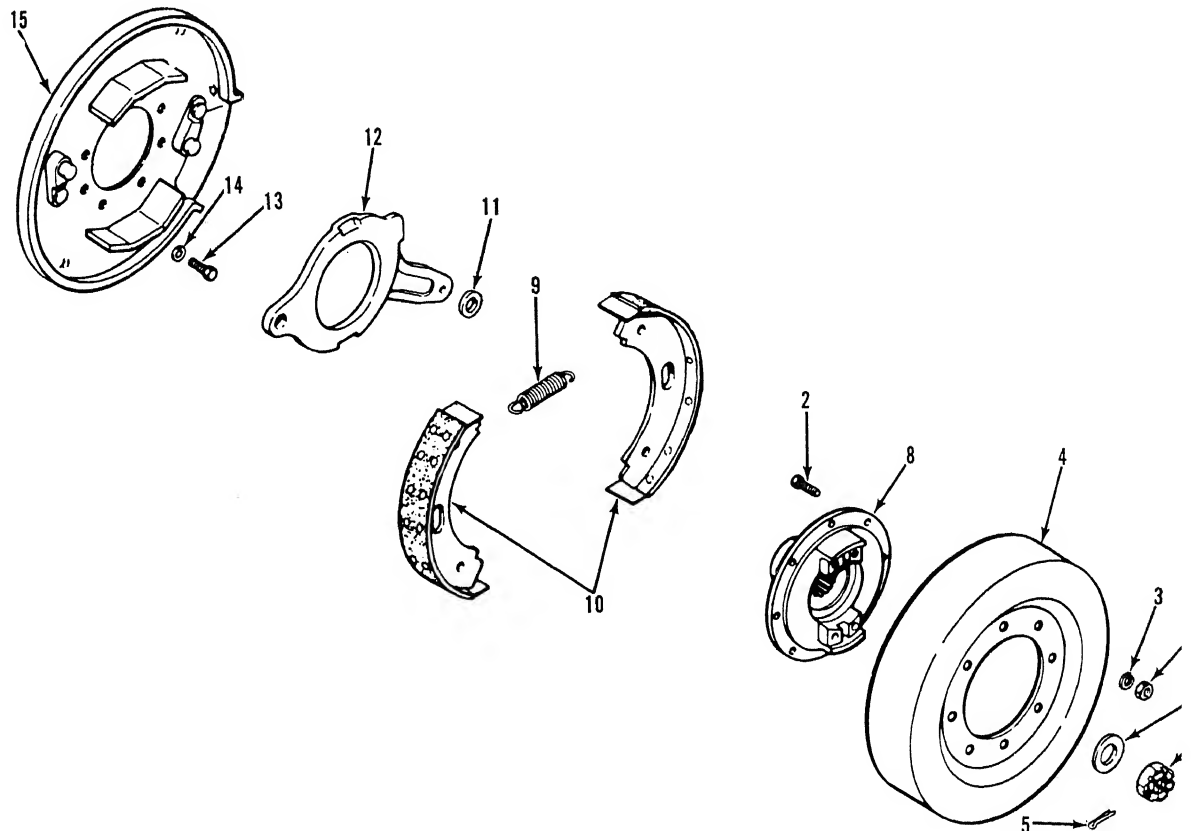
(c) Remove the nut and the flange and washer (7).

(5) Remove two return springs (9) and brake shoes (10).

(6) Remove the roller (11) from the actuating pawl.

(7) Remove lever (12).

(8) Remove seven bolts (13) and washers (14), and remove the backing plate (15) from bearing cover.



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1. Nut
2. Bolt
3. Washer
4. Brake drum
5. Cotter key
6. Pinion nut
7. Washer
8. Pinion flange

9. Spring
10. Brake shoe
11. Roller
12. Lever
13. Bolt
14. Washer
15. Backing plate

Figure 7-27. Parking brake, exploded view.

**b. Cleaning, Inspection and Repair.**

- (1) Wash all metal parts with solvent.
- (2) Inspect actuator lever and roller for excessive wear.
- (3) Inspect actuating pawls on the backing plate for excessive wear.
- (4) Inspect return springs for cracks and distortion.
- (5) Check the brake shoes for cracks and wear in the pawl slots. Replace any loose rivets.
- (6) Replace parts as necessary.

**c. Reassembly and Installation.**

(1) Position backing plate (15, fig. 7-27) on the bearing cover and secure with seven bolts (13) and washers (14).

(2) Install the actuator lever (12) on the opposite the depression in the backing plate. Ensure that the other pawl is on top of the act lever, and install roller (11) on the pawl.

(3) Position the brake shoes (10) on the backing plate, and install return springs (9).

(4) Install the pinion flange (8), nut (6) and washer (7). Tighten nut to torque value determined during disassembly. Secure with cotter key.

(5) Position the brake drum (4) on the pinion flange and secure with nuts (1), washers (3), and bolts (2).

*d. Linkage Replacement.* Refer to figure 7-28.

(1) Park the loader on firm ground and block the wheels.

(2) Remove the cotter pin (1) clevis pin (2) and washer (3) securing the brake cable (4) to the upper link (7).

(3) Remove the cotter pin (5), and clevis pin (6) securing the upper link (7) to the bellcrank and remove the upper link.

(4) Remove cotter pin (8), clevis pin (9),

cotter pin (10) and clevis pin (11), and remove the lower link (12).

(5) Remove cotter pins (13) and pin (14) and remove the bellcrank (15).

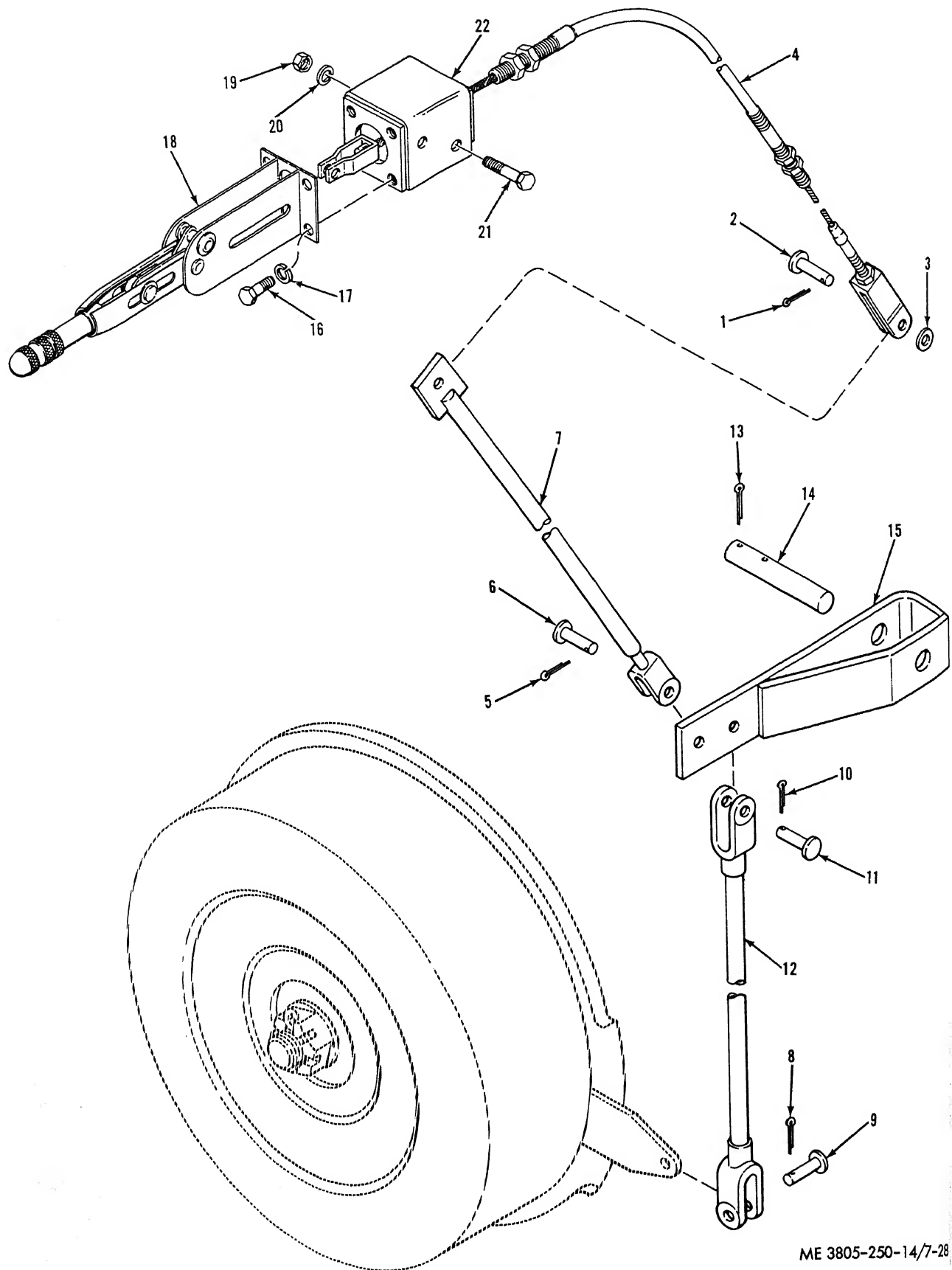
(6) Remove four bolts (16) and lockwashers (17) securing the brake lever (18) to the cab floor and remove from the loader.

(7) Remove two nuts (19), lockwashers (20) and bolts (21), and remove the brake lever bracket (22).

(8) Install linkage by reversing the removal procedure.

**KEY to fig. 7-28:**

1. Cotter pin
2. Clevis pin
3. Washer
4. Cable
5. Cotter pin
6. Clevis pin
7. Upper link
8. Cotter pin
9. Clevis pin
10. Cotter pin
11. Clevis pin
12. Lower link
13. Cotter pin
14. Pin
15. Bellcrank
16. Bolt
17. Lockwasher
18. Lever
19. Nut
20. Lockwasher
21. Bolt
22. Bracket



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Figure 7-28. Parking brake linkage replacement.

## 7-21. Wheel Brakes

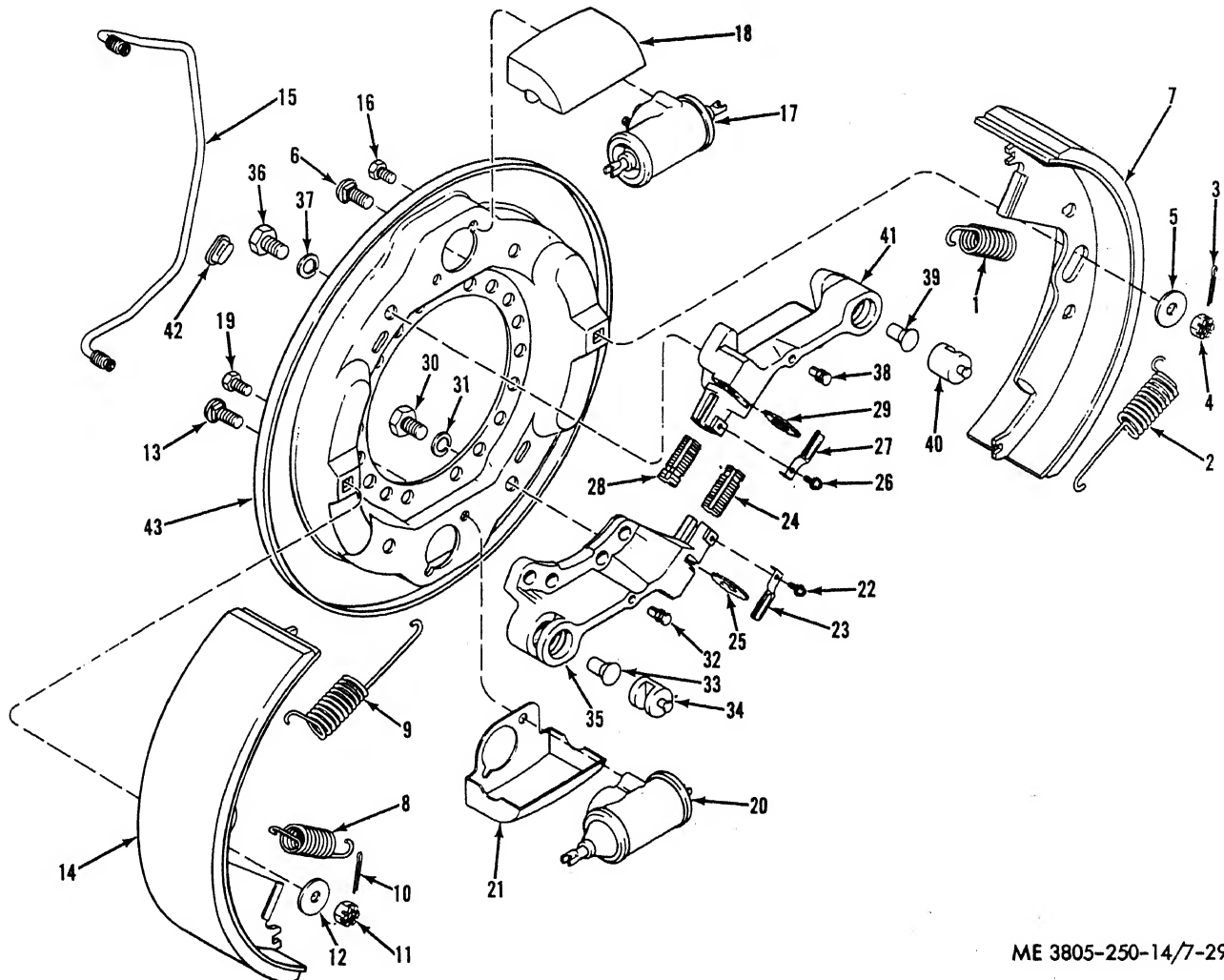
### a. Removal.

- (1) Open the drain cock on the main air reservoir to depressurize the air system.
- (2) Disconnect the line to the brake cylinder.
- (3) Remove the wheel and planetary drive (para 7-14).
- (4) Remove the brake from the axle as in-

structed in paragraph 7-14. The brake may be removed with the axle removed or installed on the loader.

b. *Disassembly of Wheel Brakes.* Refer to figure 7-29.

- (1) Rotate the brake shoe adjusting screw (24) to compress the brake return spring.



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1. Spring
2. Spring
3. Cotter pin
4. Nut
5. Flat washer
6. Bolt
7. Shoe and lining assembly
8. Spring
9. Spring
10. Cotter pin
11. Nut
12. Flat washer
13. Bolt
14. Shoe and lining assembly
15. Tube assembly

16. Capscrew
17. Wheel cylinder assembly
18. Shield
19. Capscrew
20. Wheel cylinder assembly
21. Shield
22. Screw
23. Clamp
24. Adjusting screw
25. Adjusting wheel
26. Screw
27. Clamp
28. Adjusting screw
29. Adjusting wheel

30. Capscrew
31. Lockwasher
32. Rivet
33. Anchor pin
34. Anchor pin
35. Anchor
36. Capscrew
37. Lockwasher
38. Rivet
39. Anchor pin
40. Anchor pin
41. Anchor
42. Cover
43. Backing plate

Figure 7-29. Wheel brakes, exploded view.

(2) Use brake spring pliers 5120-690-8044 (131A) shown in figure 7-30 to remove springs (1 and 2).

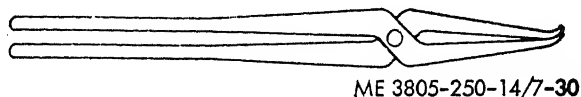


Figure 7-30. Brake spring pliers.

(3) Remove cotter pin (3, fig. 7-29), nut (4), flat washer (5) and bolt (6) securing the shoe lining assembly (7) to the backing plate.

(4) Rotate adjusting screw (28) and use the brake spring pliers to remove springs (8 and 9).

(5) Remove cotter pin (10), nut (11), flat washer (12), bolt (13), and shoe lining assembly (14).

(6) Disconnect tube (15). Cap openings.

(7) Remove screws (16), wheel cylinder (17)

and shield (18). Remove screws (19), wheel cylinder (20) and shield (21).

(8) Remove screw (22) and clamp (23). Remove adjusting screw (24) and adjusting wheel (25).

(9) Remove screw (26) and clamp (27). Remove adjusting screw (28) and adjusting clamp (29).

(10) If anchors (35 and 41) are to be replaced, remove screws (30 and 36), lockwashers (31 and 37), rivets (32 and 38) and anchors (35 and 41).

(11) Remove cover (42) from backing plate (43).

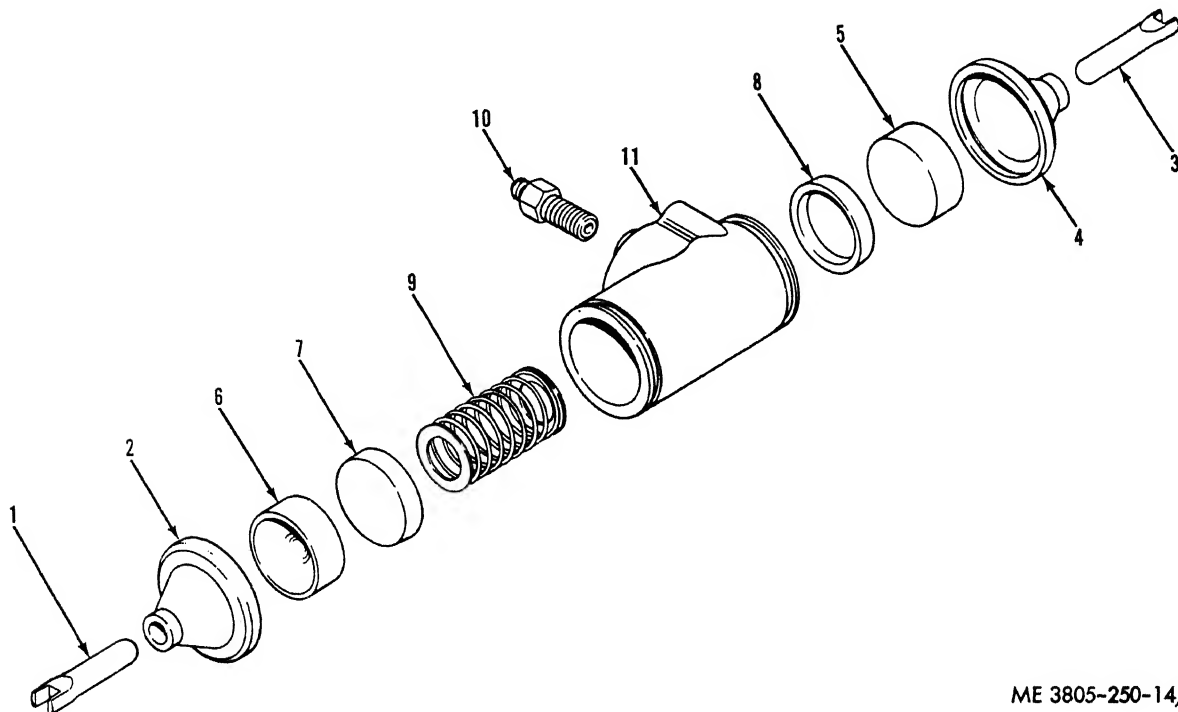
#### c. Disassembly of Wheel Cylinder.

(1) Remove push rod (1, fig. 7-31) and boot (2) from the cylinder.

(2) Remove push rod (3) and boot (4) from the opposite end of the cylinder.

(3) Remove pistons (5 and 6) cups (7 and 8) and spring (9).

(4) Remove bleeder (10) from the body (11)



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1. Push rod
2. Boot
3. Push rod
4. Boot
5. Piston
6. Piston

7. Cup
8. Cup
9. Spring
10. Bleeder
11. Body

Figure 7-31. Wheel cylinder, exploded view.



*d. Cleaning, Inspection and Repair.*

- (1) Clean all components with solvent.
- (2) Inspect housing bore for nicks, scratches, and other damage. Remove slight damage with abrasive cloth.
- (3) Inspect brake lining for oil saturation, damage, or wear. Check brake shoe for cracks and damage. Replace shoe and lining assembly if damage or wear is evident.
- (4) Examine the brake return springs for cracks and weakness. Replace as necessary.
- (5) Inspect adjusting wheels for cracked, broken, worn or missing lugs. Replace wheel if damaged or worn.
- (6) Inspect the brake anchors, anchor pins, and backing plate for cracks and other damage. Repair anchors and backing plate by welding if replacements are not immediately available. Replace damaged anchor pins.
- (7) Examine the tube for kinks, breaks, cracks, and other damage to the flared ends. Replace tube if damaged.
- (8) Inspect the wheel cylinder as follows:
  - (a) Check pistons for nicks, scratches, scoring, or wear. Repair minor damage or replace as necessary.
  - (b) Inspect cups for tears, cracks, and deterioration. Replace if damaged.
  - (c) Inspect housing bore for nicks, scratches, and other damage. If damage is excessive, replace the complete cylinder assembly.

*e. Reassembly of Wheel Cylinder.* Assemble the cylinder by reversing the disassembly procedure.

*f. Reassembly of Wheel Brakes.* Assemble brakes by reversing the disassembly procedure. Observe the following:

- (1) Tighten anchor mounting bolts to 85 to 95 pound-feet.
- (2) Tighten wheel cylinder mounting bolts to 15 to 20 pound-feet.

*g. Installation.*

(1) Install the brake assembly on the axle as described in paragraph 7-12. Tighten the brake mounting bolts to 175 to 185 pound-feet.

(2) Install the planetary drive assembly as described in paragraph 7-14.

(3) Connect the line to the brake cylinder.

(4) Perform the brake adjustment procedure (para 4-43).

(5) Start the engine and pressurize the air system. Check for leaks.

## 7-22. Hydraulic Brake Actuator

*a. Removal.* Refer to figure 7-32.

(1) Block the wheels and engage the parking brake.

(2) Open the drain cock on the main air reservoir and depressurize the system.

(3) Clean the area around the actuator to remove dirt and grease.

(4) Disconnect lines to actuator. Cap or plug lines and fittings as soon as they are disconnected.

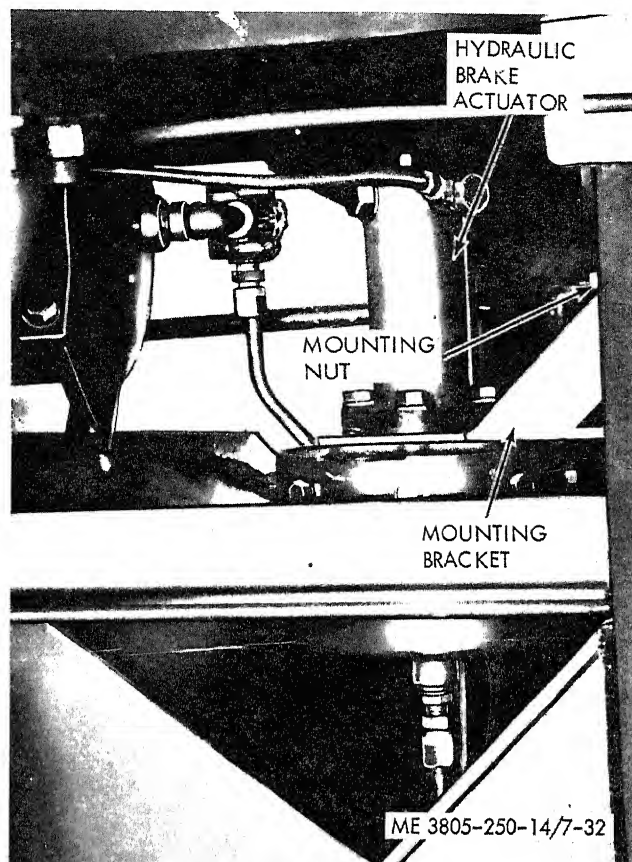


Figure 7-32. Hydraulic brake actuator, removal and installation.

(5) Remove nuts, washers, and lockwashers securing the mounting bracket to the loader. Remove actuator and mounting bracket as an assembly.

*b. Disassembly.*

*Note.* The hydraulic brake actuator consists of hydraulic cylinder and an air chamber. The two are separated and then disassembled as individual units.

(1) Draw a mark on the mounting bracket and air chamber to aid in reassembly.

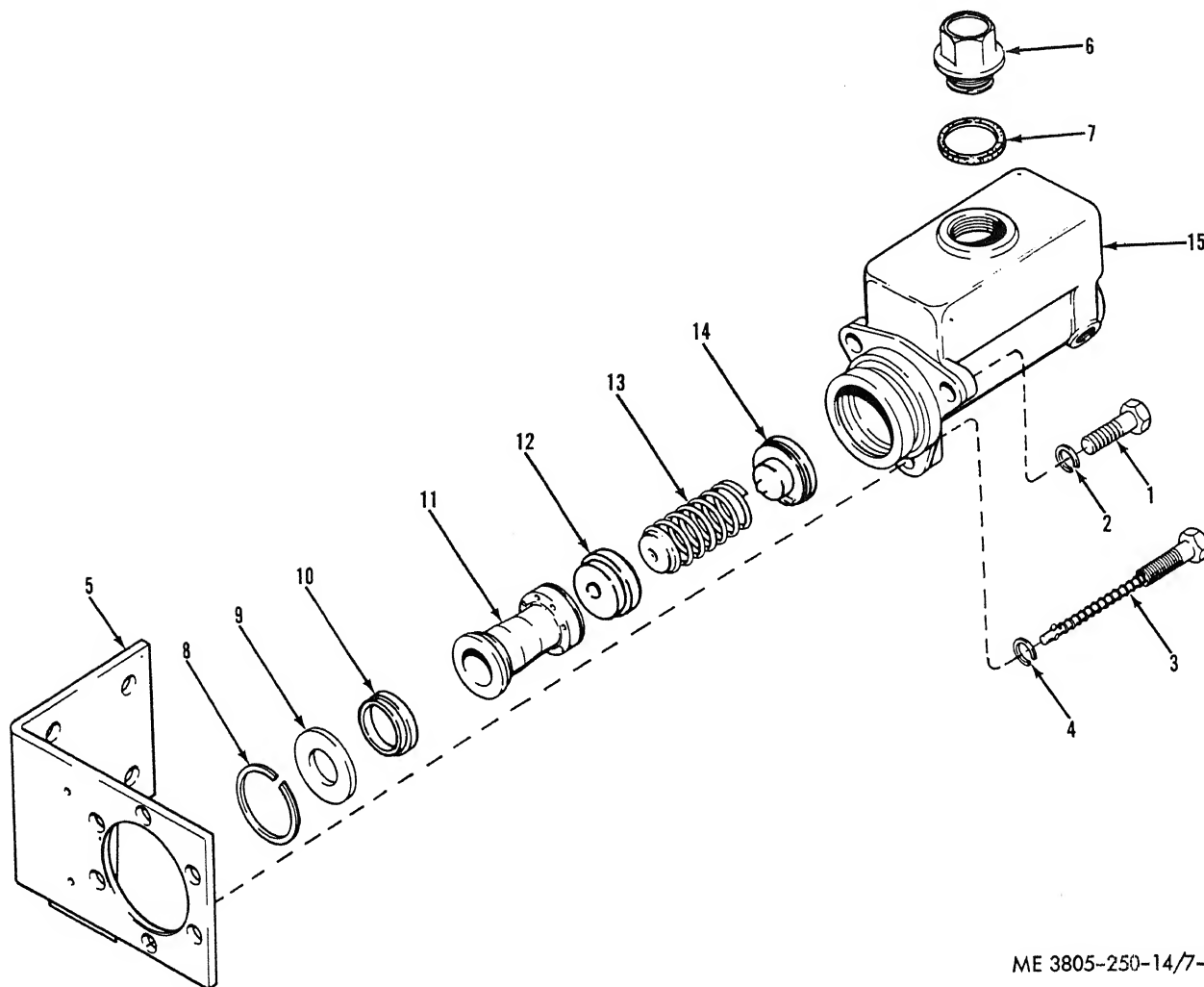
(2) Separate the air chamber and brake cylinder by removing two retaining bolts (1, fig. 7-33) and lockwasher (2) and one stroke indicator (3) and lockwasher (4). Remove mounting bracket (5).

(3) Disassemble brake cylinder as follows:

(a) Remove plug (6, fig 7-33) and gasket (7) from cylinder housing.

(b) Remove lockring (8), plate (9), packing

cup (10), piston (11), seat (12), spring (13) and check valve (14) from body (15).



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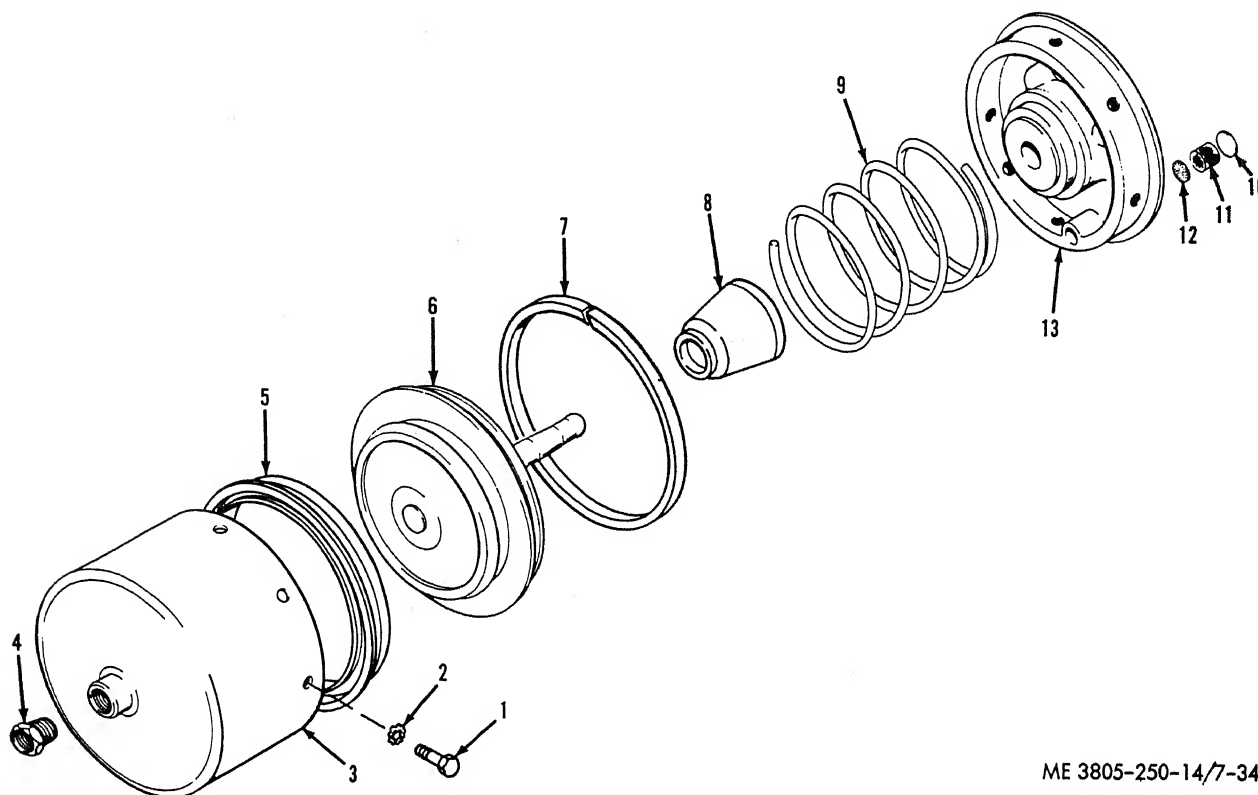
1. Bolt
2. Lockwasher
3. Stroke indicator
4. Lockwasher
5. Mounting bracket
6. Plug
7. Gasket
8. Lockring

9. Plate
10. Cup
11. Piston
12. Seat
13. Spring
14. Check valve
15. Body

Figure 7-33. Brake hydraulic cylinder, exploded view.

- (4) Disassemble the air chamber as follows:
- (a) Remove eight bolts (1, fig. 7-34) and lockwashers (2) securing the cover (3) in position. Remove the cover and remove the reducer bushing (4).
  - (b) Remove cup (5), piston (6) and wiper seal (7).

- (c) Remove piston rod boot (8) and spring (9).
- (d) Using a drift punch, drive the filter retainer (10), filter (11) and screen (12) from head (13).



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1. Bolt
2. Lockwasher
3. Cover
4. Reducer bushing
5. Cup
6. Piston
7. Wiper seal

8. Boot
9. Spring
10. Filter retainer
11. Filter
12. Screen
13. Head

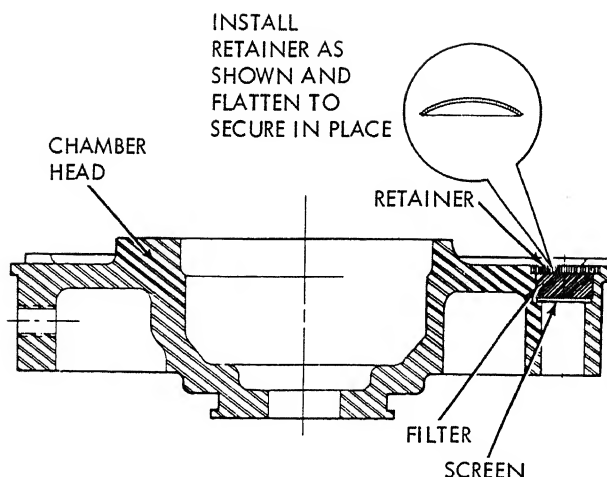
Figure 7-34. Brake air chamber, exploded view.

**c. Cleaning, Inspection and Repair.**

- (1) Clean all components with solvent.
- (2) Inspect housings for cracks, breaks or other damage.
- (3) Inspect the piston bore for nicks, scratches, scoring and other surface damage.
- (4) Inspect the piston seat and check valve for damage and wear. Check spring for cracks and wear. Replace if damaged or worn.
- (5) Inspect piston cup for cracks, deterioration, and wear. Replace if necessary.
- (6) Replace gasket and seals.
- (7) Inspect the cylinder head for damage and replace as necessary.

**d. Reassembly.**

- (1) Reassemble the air chamber as follows:
  - (a) Saturate the wiper seal (7, fig. 7-34) by soaking in 30 weight oil.
  - (b) Install the piston cup (5) and the wiper seal (7) on the piston (6). Then dip this assembly in 30 weight oil and drain.
  - (c) Coat the inside of the cover (3) with 30 weight oil.
  - (d) Install the filter screen (12), filter (11), and filter retainer (10) in the chamber head (13) as shown in figure 7-35. Position the filter retainer (10 fig. 7-34) on the head with the domed side away from the filter. Apply pressure to the screen to flatten and lock it in place.



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Figure 7-35. Air chamber filter installation.

- (e) Install the boot (8) on the piston (6).
- (f) Position the spring (9) and the chamber head (13) on the piston assembly. Install the boot on the chamber head.
- (g) Work the piston and chamber head assembly into the cover (3). Secure with bolts (1) and lockwashers (2). Ensure that the cover is seated on the shoulders of the chamber head before tightening the bolts.

- (h) Install the reducer bushing (4).
- (2) Reassemble the hydraulic cylinder by reversing the disassembly procedure.
- (3) Position the mounting bracket (5, fig. 7-33) on the hydraulic cylinder.
- (4) Align the marks made on the bracket and air chamber during disassembly. Secure the air chamber, bracket, and cylinder with two bolts (1) and lockwashers (2) and stroke indicator (3) and lockwasher (4).

*e. Installation.*

- (1) Install the actuator by reversing the removal procedure.
- (2) Close the drain cock on the main reservoir. Start the engine to pressurize the system and check for leaks.

### 7-23. Brake Air Valve

*a. Removal.* Refer to paragraph 4-45.

*b. Disassembly.*

- (1) Remove cotter key (1, fig. 7-36) and slide roller pin (2) from roller (3).
- (2) Remove cotter key (4) and slide fulcrum

pin (5) from the treadle plate. Remove the boot (7), plunger (8), and stop button (9). (3) Remove four bolts (10) and lockwashers (11) securing the treadle plate (12) to the housing, and remove the treadle plate.

(4) Depress the piston assembly and remove the piston retainer (13). Remove the piston assembly and return spring (14) from the valve body.

(5) Remove preformed packing (15) from the piston (21). Remove filter (16) from the groove in the body (33).

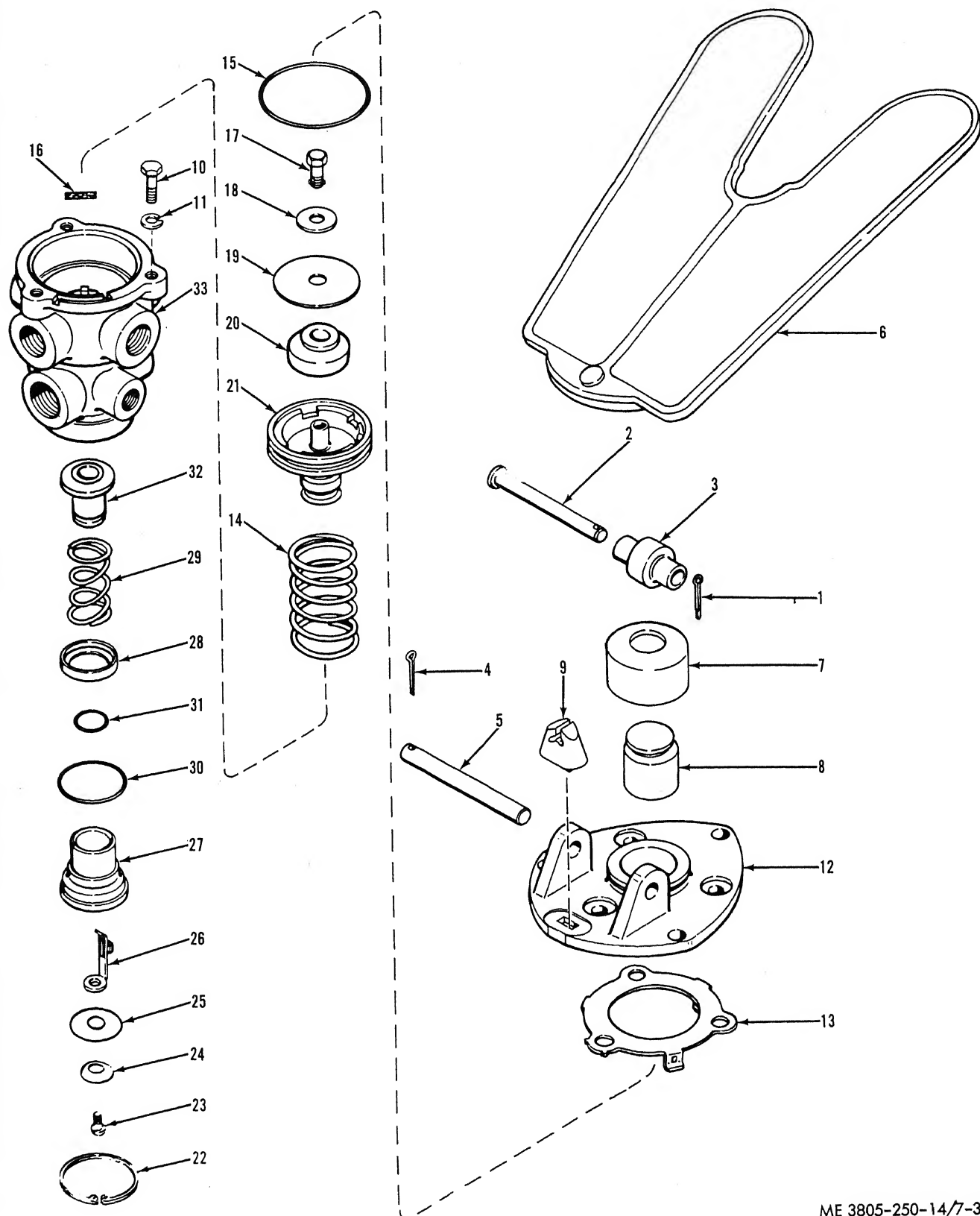
(6) Remove capscrew (17), washer (18), spring seat (19), and rubber spring (20) from piston (21).

(7) Depress inlet/exhaust valve and remove retaining ring (22). Remove the valve assembly from the body.

(8) Remove screw (23), washer (24), diaphragm (25) and spring (26). Remove seat (27), spring seat (28), and spring (29). Discard preformed packings (30 and 31).

**KEY to fig. 7-35**

- 1. Cotter key
- 2. Roller pin
- 3. Roller
- 4. Cotter key
- 5. Fulcrum pin
- 6. Treadle
- 7. Boot
- 8. Plunger
- 9. Button
- 10. Bolt
- 11. Lockwasher
- 12. Treadle plate
- 13. Piston retainer
- 14. Spring
- 15. Preformed packing
- 16. Filter
- 17. Capscrew
- 18. Washer
- 19. Seat
- 20. Spring
- 21. Piston
- 22. Retaining ring
- 23. Screw
- 24. Washer
- 25. Diaphragm
- 26. Spring
- 27. Seat
- 28. Spring seat
- 29. Spring
- 30. Preformed packing
- 31. Preformed packing
- 32. Inlet/exhaust valve
- 33. Body



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Figure 7-36. Brake air valve, exploded view.

**c. Cleaning, Inspection and Repair.**

(1) Clean all components in solvent. Wipe rubber parts with a dry cloth.

(2) Inspect all metal parts for cracks, wear, and corrosion.

(3) Inspect valve and valve seats for nicks and burrs. Replace as necessary.

(4) Check springs for distortion and cracks.

(5) Check exhaust diaphragm for flexibility, wear and deterioration. Replace as necessary.

**d. Reassembly.**

(1) Lubricate preformed packings, piston, and valve bores.

(2) Position the rubber spring (20, fig. 7-36) on piston (21). Install seat (19) and washer (18). Tighten cap screw (17) to 50 pound-inches.

(3) Install new preformed packing (15) on piston. Place piston return spring (14) in the body, and install the piston assembly. Be careful not to damage the piston packing. Install the filter (16) in the grooves in the body (33).

(4) Install piston retainer (13) so that the prongs snap over the grooves in the valve body (33).

(5) Position preload spring (26) in the exhaust valve seat (27). Install preformed packing (30) on seat (27) and preformed packing (31) on the inlet/exhaust valve (32).

(6) Position spring (29) on seat (28), install the inlet/exhaust valve, spring and exhaust valve seat assemblies in the valve body. Push valve down until the preload spring (26) snaps into the valve body.

(7) Install diaphragm (25) and washer (24). Secure diaphragm and washer with screw (23). Press down on washer and diaphragm and install retaining ring (22). Ensure that the retaining ring snaps into the groove in the valve body.

(8) Install treadle plate (12) on the valve, secure with four cap screws (10) and lock washers (11).

(9) Position button (9), plunger (8), and pin (7) on the treadle plate. Install treadle (6) and secure with fulcrum pin (5). Insert cotter key (4).

(10) Install roller (3) with roller pin (2) and cotter key (1).

**e. Installation.** Refer to paragraph 4-45.

**7-24. Brake Lines, Hose and Fittings Replacement**

Replace worn, broken or otherwise defective lines or hose with a new component. Replace leaking or damaged fittings.

**Section VI. WHEELS**

**7-25. General**

The four wheels of the loader have tubeless rubber tires. The tires are mounted on the wheels with a flange and a lockring.

**7-26. Wheels**

**a. Removal.**

(1) Remove the tire (para 4-46).

(2) Remove twelve nuts securing the wheel to the axle and remove the wheel.

**b. Cleaning, Inspection and Repair.**

(1) Wash the wheel with soap and a scrub brush.

(2) Inspect wheel for cracks, breaks, or other damage. Repair cracks or breaks in the rim by welding, if possible.

(3) Replace damaged components.

(4) Inspect wheel for out-of-round condition and repair, if possible.

**c. Installation.**

(1) Install the wheel on the axle and secure with twelve nuts. Tighten nuts to 365 to 400 pound-feet.

(2) Install the tire (para 4-46).

**Section VII. STEERING SYSTEM**

**7-27. General**

**a.** The steering system is powered by a combination of manual effort and hydraulic power supplied by the hydraulic system. The system consists of the steering wheel, steering linkage, steering gear, hydraulic pump, control valve, flow divider valve, and two hydraulic cylinders.

**b.** When the steering wheel is turned, the force exerted is transferred through the linkage to the steering gear to position the control valve spool for the turn. The position of the spool controls the hydraulic flow to the cylinders, retracting or extending the cylinders and turning the loader.

c. Refer to figure 1-4 for a schematic diagram of the hydraulic system.

## 7-28. Steering Gear Assembly

### a. Removal.

(1) Steam-clean the steering gear and surrounding area before removal.

(2) Close the air valve at the hydraulic reservoir, and slowly withdraw the dipstick to depressurize the steering system. Open the drain on the main air reservoir.

(3) Remove the front section of the floorboard for access to the steering gear as instructed in paragraph 4-52.

(4) Remove the button (1, fig. 7-37) from the steering wheel, and remove the retaining nut (2). Mark the steering wheel and shaft for correct reassembly.

(5) Use a puller to remove the steering wheel (3) from the shaft. Remove the spring (4), washer (5), and bearing (6) from the shaft.

(6) Remove the steering column clamp retaining bolts (7) and washers (8), and remove the clamp (9).

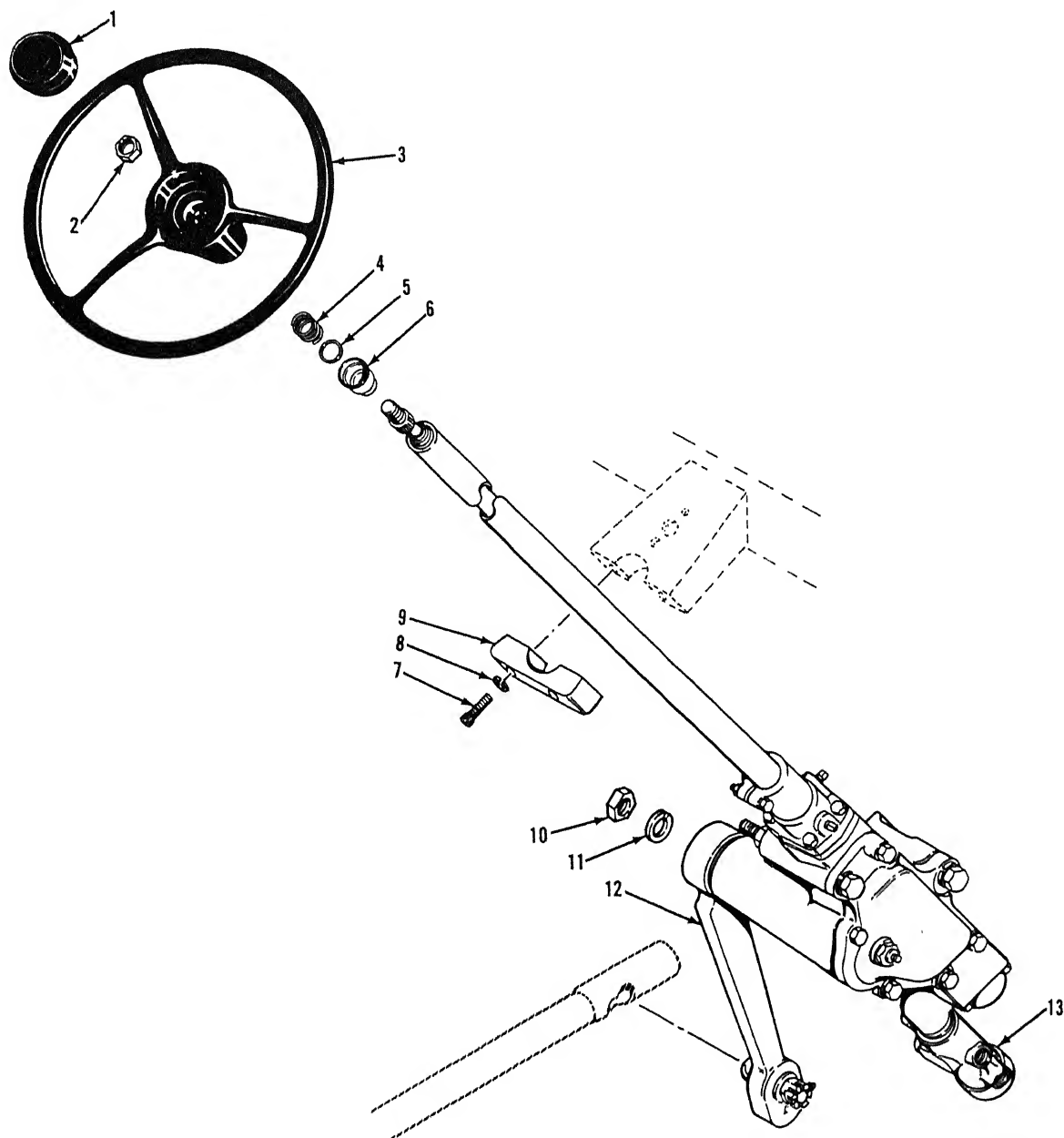
(7) Remove the pitman arm retaining nut (10) and lockwasher (11). Mark the pitman arm and shaft for correct alignment during installation. Use a puller to remove the pitman arm (12) from its shaft. Reinstall the nut (10) and lockwasher (11).

(8) Disconnect the four hydraulic lines to the steering control valve (13). Cap or plug lines and fittings as soon as they are disconnected.

(9) Remove mounting nuts and lockwashers and remove the steering gear from the loader.

### KEY to fig. 7-37:

1. Button
2. Nut
3. Steering wheel
4. Spring
5. Washer
6. Bearing
7. Bolt
8. Lockwasher
9. Clamp
10. Nut
11. Lockwasher
12. Pitman arm
13. Steering control valve



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Figure 7-37. Steering gear assembly, removal and installation.

**d. Disassembly.**

(1) Remove the drain plug (1, fig. 7-38) and drain hydraulic fluid from the gear.

*Note.* Nut (2), spring (3), washer (4), and bearing (5) were removed from the column when the steering wheel was removed.

(2) Remove nut (6), lockwasher (7), and bolt (8) securing the cover clamp, and slide tube (9) from the cover (41).

(3) Remove two screws (10) and washers (11), two screws (12) and washers (13), and remove cover (14) and control valve assembly (15). Discard gasket (16).

(4) Remove actuator lever seal (17).

(5) Remove two screws (18) and shakeproof lockwashers (19) securing the mounting bracket (20) to the housing (61). Remove lever (21) and discard gasket (22).



(6) Remove nut (23) and lockwasher (24) from the end of the pitman shaft:

(7) Remove the adjusting screw retaining nut (25), three bolts (26), three washers (27), three washers (28), and three nuts (29). Remove four bolt and washer assemblies (30) and remove the side cover (31). Discard gasket (32).

(8) Unlock the retainer (33) and remove adjusting screw (34).

(9) Remove nut (35), external tooth lockwasher (36) and lever shaft bearing (37).

(10) Slide the shaft and lever assembly (38) from the housing.

(11) Remove plug (39) from upper cover. Remove four bolts (40) securing upper cover (41) to the housing. Remove the cover and discard gasket (42).

(12) Remove screw (43) and lockwasher (44) from the actuator housing.

(13) Remove four bolts (45) and washers (46) securing the end cover (47) to the actuator housing. Remove the cover and discard gasket (48).

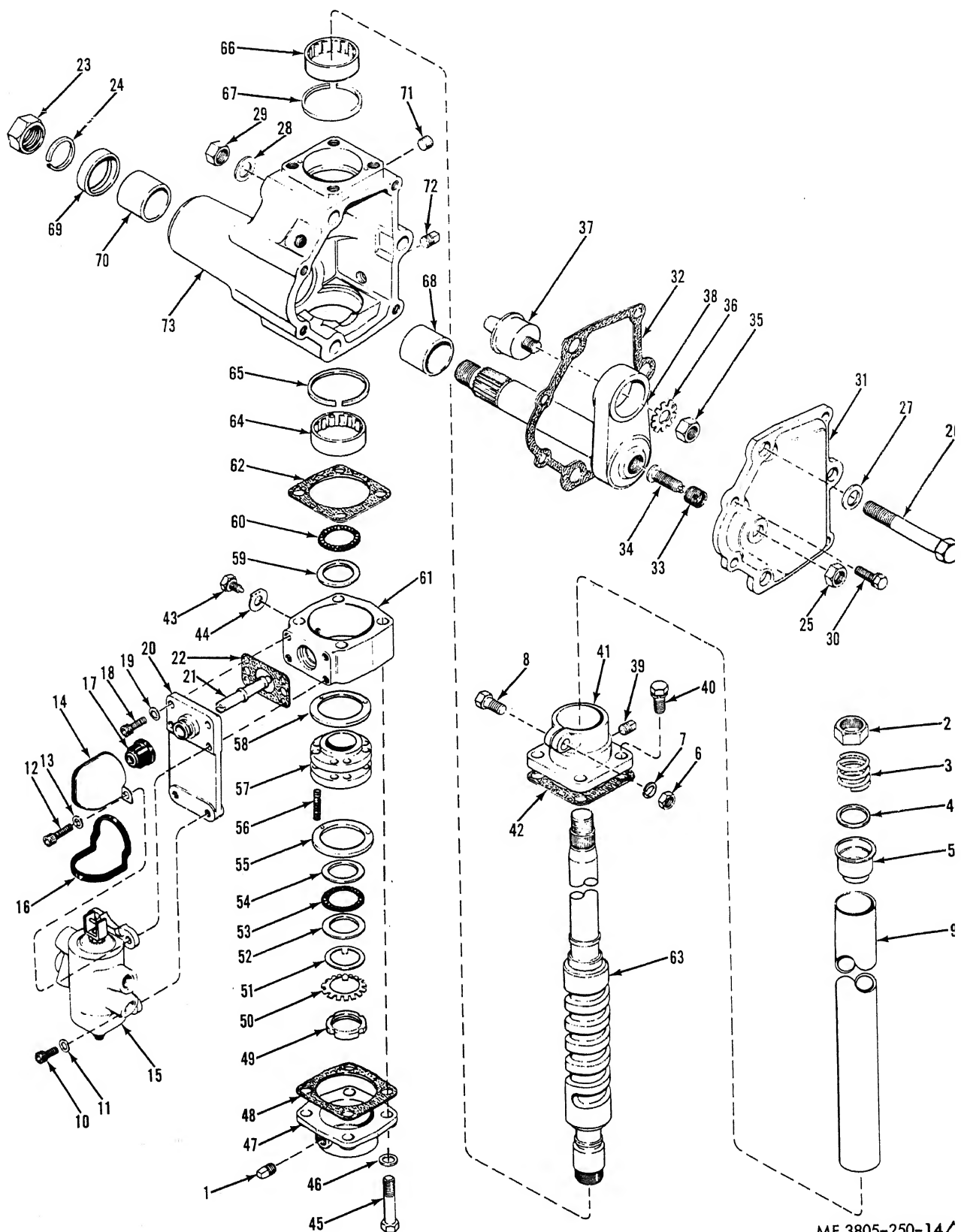
(14) Remove locknut (49), lockwasher (50), tongued washer (51), thrust washer (52), thrust bearing (53), thrust washer (54), and centering washer (55) from the end of the camshaft. Remove four springs (56), steering gear actuator (57), centering washer (58), thrust washer (59) and thrust bearing (60). Remove actuator housing (61), and discard gasket (62).

(15) Slide the camshaft (63) from the housing. Remove bearing (64) and retaining ring (65) from shaft. Remove bearing (66) and retaining ring (67).

(16) Remove bushing (68), seal (69), bushing (70), and plugs (71 and 72) from housing (73).

KEY to fig. 7-38:

- |                              |                              |
|------------------------------|------------------------------|
| 1. Drain plug                | 37. Lever shaft bearing      |
| 2. Nut                       | 38. Shaft and lever assembly |
| 3. Spring                    | 39. Plug                     |
| 4. Washer                    | 40. Bolt                     |
| 5. Bearing                   | 41. Cover                    |
| 6. Nut                       | 42. Gasket                   |
| 7. Lockwasher                | 43. Screw                    |
| 8. Bolt                      | 44. Lockwasher               |
| 9. Tube                      | 45. Bolt                     |
| 10. Screw                    | 46. Washer                   |
| 11. Washer                   | 47. Cover                    |
| 12. Screw                    | 48. Gasket                   |
| 13. Washer                   | 49. Locknut                  |
| 14. Cover                    | 50. Lockwasher               |
| 15. Control valve assembly   | 51. Tongued washer           |
| 16. Gasket                   | 52. Thrust washer            |
| 17. Seal                     | 53. Thrust bearing           |
| 18. Screw                    | 54. Thrust washer            |
| 19. Lockwasher               | 55. Centering washer         |
| 20. Mounting bracket         | 56. Spring                   |
| 21. Lever                    | 57. Steering gear actuator   |
| 22. Gasket                   | 58. Centering washer         |
| 23. Nut                      | 59. Thrust washer            |
| 24. Lockwasher               | 60. Thrust bearing           |
| 25. Retaining nut            | 61. Actuator housing         |
| 26. Bolt                     | 62. Gasket                   |
| 27. Washer                   | 63. Camshaft                 |
| 28. Washer                   | 64. Bearing                  |
| 29. Nut                      | 65. Retaining ring           |
| 30. Bolt and washer assembly | 66. Bearing                  |
| 31. Cover                    | 67. Retaining ring           |
| 32. Gasket                   | 68. Bushing                  |
| 33. Retainer                 | 69. Seal                     |
| 34. Adjusting screw          | 70. Bushing                  |
| 35. Nut                      | 71. Plug                     |
| 36. Lockwasher               | 72. Plug                     |
|                              | 73. Housing                  |



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Figure 7-38. Steering gear, exploded view.

*c. Cleaning, Inspection and Repair.*

(1) Clean all steering gear components with solvent.

(2) Inspect the cam groove for chipping, scoring and pitting. Wear of the copper plating is normal.

(3) Inspect bearing surfaces at each end of the cam.

(4) Inspect the pitman arm shaft for burred and twisted spline and worn bushing surfaces.

(5) Inspect the cam stud for nicks, flat spots and pitting.

(6) Check all bearings for flat spots and pitting.

(7) Inspect gear housing for cracks or other damage.

(8) Inspect seals and bushings for wear.

(9) Inspect thrust washers for wear.

(10) Replace all gaskets.

*d. Reassembly.* Refer to figure 7-38.

(1) Check the thread condition on the lower end of the camshaft (63) and locknut (49). If the locknut cannot be screwed all the way on by hand, clean the threads.

(2) Install the upper thrust bearing (60), thrust washer (59), centering washer (58), actuator (57), four springs (56), lower centering washer (55), thrust washer (54), thrust bearing (53) and thrust washer (52) on the lower end of the camshaft (63). Install tongued washer (51) and lockwasher (50) and secure with nut (49). Torque the nut to 10 pound-feet and back off  $1\frac{1}{2}$  lugs. Bend a tab on the lockwasher against the nut.

*Note.* A new lockwasher (50) should be used. If the oil lockwasher is installed, bend back a tab that has never been used.

(3) Press the upper camshaft bearing (66), retaining ring (67), lower camshaft bearing (64) and retaining ring (65) into the housing (73). Install pitman shaft bushings (68 and 70), seal (69), and plugs (71 and 72) in the housing.

(4) Insert the camshaft into the housing and check for free radial and vertical movement.

(5) Position a new gasket (62) at the bottom of the housing and slide the actuator housing (61) over the actuator (57). Secure with actuator retaining screw (43) and lock (44). Ensure that the screw engages the horizontal slot in the actuator.

(6) Install gasket (48) and lower cover (47) on the actuator housing. Secure with four bolts (45) and washers (46), tightening bolts evenly. Install drain plug (1).

(7) Position a new upper cover gasket (42) on top of housing. Slide the tube (9) and upper cover (41) over the shaft. Secure the tube to the upper

cover with bolt (8), lockwasher (7) and nut (6). Secure the upper cover with four bolts (40) and tighten bolts evenly.

(8) Press the lever shaft bearing (37) into the shaft and lever assembly (38) and secure with nut (35) and lockwasher (36). Lubricate the bearing, and check rotating torque for  $2\frac{1}{2}$  pound-inches. Tighten or loosen nut (35) to obtain proper torque. Bend a new prong of the lockwasher against the nut.

(9) Install adjusting screw (34) and retainer (33), screwing in the retainer to eliminate end play between the shaft and the screw. The screw should turn freely.

(10) Carefully insert the shaft and lever assembly (38) into the housing (73).

(11) Position a new gasket (32) on the side of the housing (73). Position the cover (31) over the adjusting screw (34). Secure with four bolt and washer assemblies (30) and three bolts (26), three washers (27), three washers (28) and three nuts (29).

(12) Turn the adjusting screw (34) clockwise until a slight drag (5 to 8 pound-inches) is felt when turning the gear through mid position. Install locknut (25) and turn the gear through full travel to check the adjustment. Slight drag should be felt at mid-position.

*Note.* Play in the pitman arm must not exceed  $1/32$  inch.

(13) Position lever (21) in the actuator housing. Position a new gasket (22) on the housing and install mounting bracket (20). Install top two mounting screws (18) and lockwashers (19). Position the control valve (15) and cover (14) with new gasket (16) on the mounting bracket. Secure with two screws (12) and washers (13) and two screws (10) and washers (11).

*Note.* Whenever the control valve is removed from the gear housing, the valve spool must be adjusted. Refer to paragraph 7-29.

(14) Install nut (23) and lockwasher (24) or end of housing.

*e. Installation.*

(1) Position the steering gear on the mounting bracket in the loader (fig. 7-37).

(2) Secure the steering column with clamp (9) and two bolts (7) and lockwashers (8).

(3) Install three steering gear mounting nuts and lockwashers. Tighten the nuts to 150 to 165 pound-feet. Rotate the column and check for binding or excessive drag.

(4) Position the pitman arm (12) on the steering gear shaft. Align marks made during

*c. Cleaning, Inspection and Repair.*

(1) Clean all steering gear components with solvent.

(2) Inspect the cam groove for chipping, scoring and pitting. Wear of the copper plating is normal.

(3) Inspect bearing surfaces at each end of the cam.

(4) Inspect the pitman arm shaft for burred and twisted splines and worn bushing surfaces.

(5) Inspect the cam stud for nicks, flat spots and pitting.

(6) Check all bearings for flat spots and pitting.

(7) Inspect gear housing for cracks or other damage.

(8) Inspect seals and bushings for wear.

(9) Inspect thrust washers for wear.

(10) Replace all gaskets.

*d. Reassembly. Refer to figure 7-38.*

(1) Check the thread condition on the lower end of the camshaft (63) and locknut (49). If the locknut cannot be screwed all the way on by hand, clean the threads.

(2) Install the upper thrust bearing (60), thrust washer (59), centering washer (58), actuator (57), four springs (56), lower centering washer (55), thrust washer (54), thrust bearing (53) and thrust washer (52) on the lower end of the camshaft (63). Install tongued washer (51) and lockwasher (50) and secure with nut (49). Torque the nut to 10 pound-feet and back off  $1\frac{1}{2}$  lugs. Bend a tab on the lockwasher against the nut.

*Note.* A new lockwasher (50) should be used. If the oil lockwasher is installed, bend back a tab that has never been used.

(3) Press the upper camshaft bearing (66), retaining ring (67), lower camshaft bearing (64) and retaining ring (65) into the housing (73). Install pitman shaft bushings (68 and 70), seal (69), and plugs (71 and 72) in the housing.

(4) Insert the camshaft into the housing and check for free radial and vertical movement.

(5) Position a new gasket (62) at the bottom of the housing and slide the actuator housing (61) over the actuator (57). Secure with actuator retaining screw (43) and lock (44). Ensure that the screw engages the horizontal slot in the actuator.

(6) Install gasket (48) and lower cover (47) or the actuator housing. Secure with four bolts (45) and washers (46), tightening bolts evenly. Install drain plug (1).

(7) Position a new upper cover gasket (42) on top of housing. Slide the tube (9) and upper cover (41) over the shaft. Secure the tube to the upper

cover with bolt (8), lockwasher (7) and nut (6). Secure the upper cover with four bolts (40) and tighten bolts evenly.

(8) Press the lever shaft bearing (37) into the shaft and lever assembly (38) and secure with nut (35) and lockwasher (36). Lubricate the bearing, and check rotating torque for  $2\frac{1}{2}$  pound-inches. Tighten or loosen nut (35) to obtain proper torque. Bend a new prong of the lockwasher against the nut.

(9) Install adjusting screw (34) and retainer (33), screwing in the retainer to eliminate end play between the shaft and the screw. The screw should turn freely.

(10) Carefully insert the shaft and lever assembly (38) into the housing (73).

(11) Position a new gasket (32) on the side of the housing (73). Position the cover (31) over the adjusting screw (34). Secure with four bolt and washer assemblies (30) and three bolts (26), three washers (27), three washers (28) and three nuts (29).

(12) Turn the adjusting screw (34) clockwise until a slight drag (5 to 8 pound-inches) is felt when turning the gear through mid position. Install locknut (25) and turn the gear through full travel to check the adjustment. Slight drag should be felt at mid-position.

*Note.* Play in the pitman arm must not exceed  $1/32$  inch.

(13) Position lever (21) in the actuator housing. Position a new gasket (22) on the housing and install mounting bracket (20). Install top two mounting screws (18) and lockwashers (19). Position the control valve (15) and cover (14) with new gasket (16) on the mounting bracket. Secure with two screws (12) and washers (13) and two screws (10) and washers (11).

*Note.* Whenever the control valve is removed from the gear housing, the valve spool must be adjusted. Refer to paragraph 7-29.

(14) Install nut (23) and lockwasher (24) on end of housing.

*e. Installation.*

(1) Position the steering gear on the mounting bracket in the loader (fig. 7-37).

(2) Secure the steering column with clamp (9) and two bolts (7) and lockwashers (8).

(3) Install three steering gear mounting nuts and lockwashers. Tighten the nuts to 150 to 165 pound-feet. Rotate the column and check for binding or excessive drag.

(4) Position the pitman arm (12) on the steering gear shaft. Align marks made during

disassembly. Secure with the bolt (11) and lockwasher (10) on the end of the shaft. Tighten to 250 pound-feet.

(5) Connect hydraulic lines to the control valve ports.

(6) Fill the gear housing with gear lubricant.

(7) Install the floorboard (para 4-52).

(8) Insert the bearing (6) into the end of the column. Install washer (5) and spring (4), and secure steering wheel (3) with nut (2). Tighten nut to 15 to 25 pound-feet and install the steering wheel button (1).

(9) Open the air valve at the hydraulic reservoir and install the dipstick. Close the main air reservoir drain cock.

(10) Start the engine and check for air and hydraulic leaks.

### 7-29. Steering Control Valve

*a. Removal.* Whenever the control valve must be removed, the entire steering gear should be removed. Refer to paragraph 7-28 for steering gear

removal and removal of the control valve from steering gear.

#### *b. Disassembly.*

(1) Remove two screws (1, fig. 7-39) shakeproof washers (2) from the bottom of valve, and remove oil seal retainer (3), oil seal valve spool cover (5), preformed packing (6), sleeve retainer (7).

(2) Remove the cotter pin (8) from the clevis rod nut. Remove the clevis assembly (9), nut (10) and lockwasher (11).

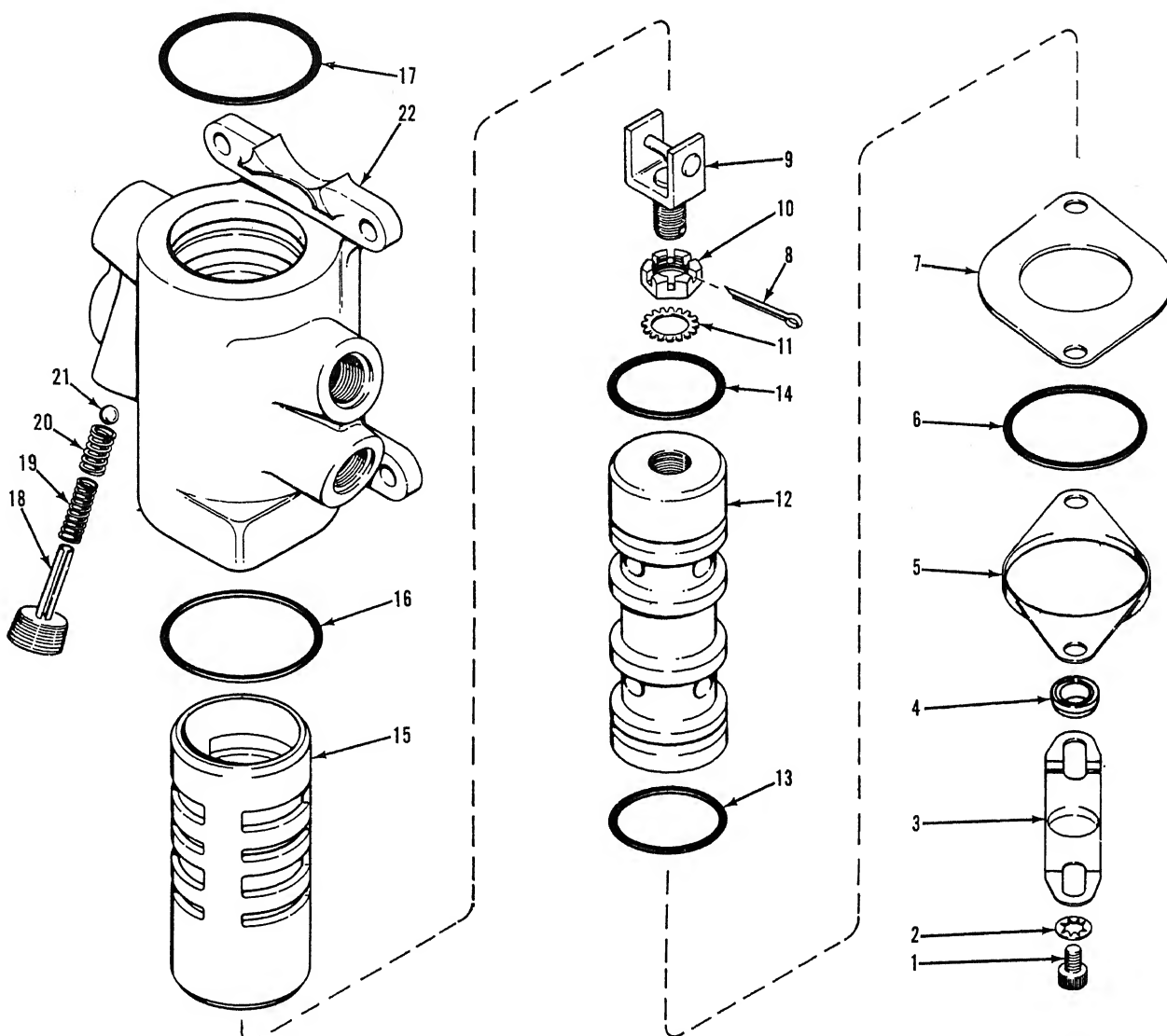
(3) Push the valve spool (12) out through bottom of the valve body and remove preformed packing (13). Push the spool out the top of body and remove preformed packing (14).

(4) Push the sleeve (15) out the top of valve body and remove preformed packing (16) from the bottom of the body. Push the sleeve to the bottom of the body and remove O-ring (17).

(5) Remove check valve plug (18), springs (19) and 20) and ball (21) from the valve body (22).

#### KEY to fig. 7-39

1. Screw
2. Washer
3. Oil seal retainer
4. Oil seal
5. Cover
6. Preformed packing
7. Sleeve retainer
8. Cotter pin
9. Clevis assembly
10. Nut
11. Lockwasher
12. Spool
13. Preformed packing
14. O-ring
15. Sleeve
16. Preformed packing
17. Preformed packing
18. Plug
19. Spring
20. Spring
21. Ball
22. Valve body



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Figure 7-39. Steering control valve, exploded view.

**c. Cleaning, Inspection and Repair**

- (1) Clean all metal parts with solvent.
- (2) Inspect valve body for cracks or other damage. Ensure that the valve port is open.
- (3) Inspect the sleeve bore and valve spool for scoring and excessive wear.
- (4) Inspect the check valve ball for wear.
- (5) Inspect check valve springs for distortion and other damage.
- (6) Check clevis pin for wear. Ensure that the clevis fits tightly on the rod.
- (7) Replace all preformed packings and the oil seal.

**d. Reassembly.** Assemble the control valve by reversing the disassembly procedure. Do not install

the valve spool cover (5, fig. 7-39), preformed packing (6), sleeve retainer (7), oil seal (4), seal retainer (3), washer (2) or bolt (1). First install the control valve on the steering gear (para 7-27) and perform the valve spool adjustment procedure (subpara e)

**e. Valve Spool Adjustment.**

**Note.** This procedure is performed with the valve spool cover removed and the valve installed on the steering gear.

- (1) Insert a screwdriver into the slot on the valve spool and thread the spool in or out until the slotted end of the spool is flush with the bottom of the valve body, figure 7-40.

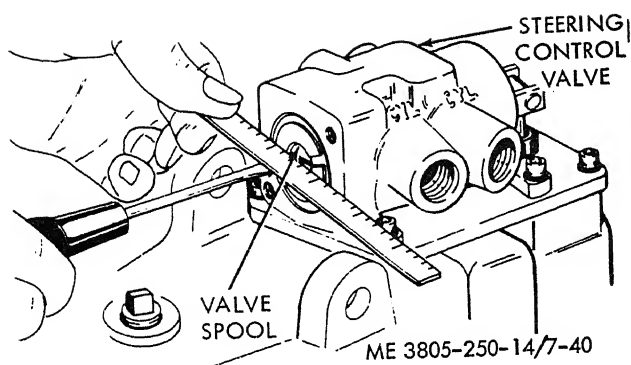


Figure 7-40. Steering control valve, spool adjustment.

(2) Tighten the clevis rod locknut while maintaining the valve spool position by keeping the screwdriver in the slot (fig. 7-41). Secure with the cotter pin.

*Note.* The slightest change in valve spool position will affect adjustment.

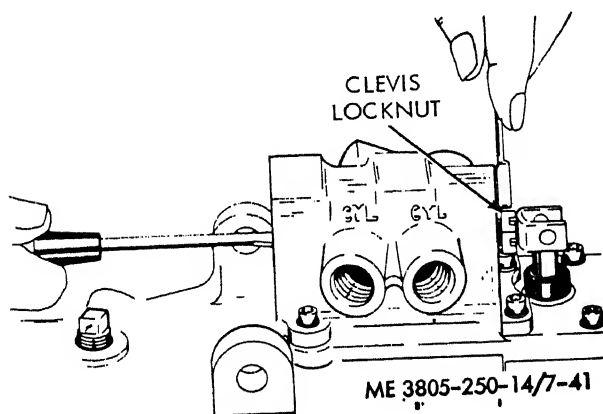


Figure 7-41. Tightening clevis locknut.

(3) Install cover and remaining components in the valve and tighten screws.

*f. Installation.* Refer to paragraph 7-28.

### 7-30. Flow Divider Valve

#### *a. Removal and Disassembly.*

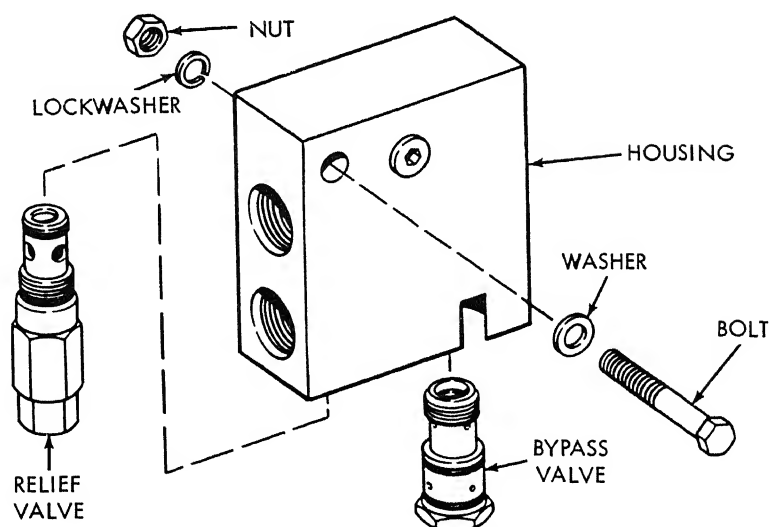
(1) Close the air valve on the hydraulic reservoir and depressurize the reservoir.

(2) Steam-clean the valve and surrounding area to remove dirt and grease.

(3) Disconnect the control valve and reservoir return lines from the flow divider valve (fig. 7-42). Disconnect the relief valve line. Cap or plug line and fittings as soon as they are disconnected.

(4) Remove mounting nut, lockwasher, wash and bolt, and remove the valve from its mounting bracket.

(5) Remove the relief valve and the bypass valve from the housing.



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Figure 7-42. Flow divider valve, exploded view.

**b. Cleaning, Inspection and Repair.**

- (1) Clean valve parts with solvent
- (2) Inspect valve housing for cracks and other damage.

- (3) Inspect the relief valve and bypass valve for damage. If either valve is defective, that valve must be replaced as a complete assembly.

**c. Reassembly and Installation.**

- (1) Assemble and install the valve by reversing the removal and disassembly procedure.
- (2) Open the air valve on the hydraulic reservoir, and start the engine and check for leaks.
- (3) Check the hydraulic reservoir oil level and add oil as necessary.

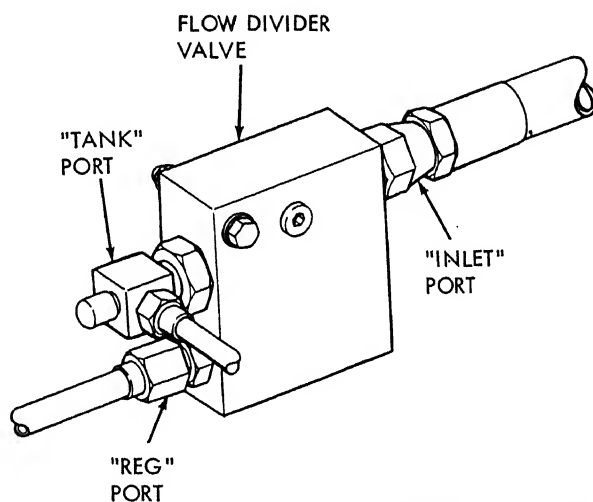
**d. Relief Valve Pressure Check.**

*Note.* The relief valve is set for 2200 to 2300 psi at 25 gpm. If valve does not operate in this range, it must be replaced.

- (1) Close the air valve on the hydraulic reservoir and slowly loosen the reservoir filler cap to depressurize the steering system.

- (2) Disconnect the line from the "REG" port of the flow divider valve (fig. 7-43).

- (3) Cap the line and install a 90° elbow on the port.



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Figure 7-43. Steering relief valve pressure check.

- (4) Connect a 2500 psi pressure gage to the elbow.

**WARNING:** Ensure that the pressure gage has a line long enough to permit the mechanic to stand away from the loader and read the gauge. Do not stand between the chassis sections when performing this test.

- (5) Start the engine and run at high idle (1800 rpm). Slowly position the loader in a full right or full left turn. If the pressure gauge does not register between 2200 and 2300 psi, replace the relief valve cartridge.



## 7-31. Steering Hydraulic Cylinders

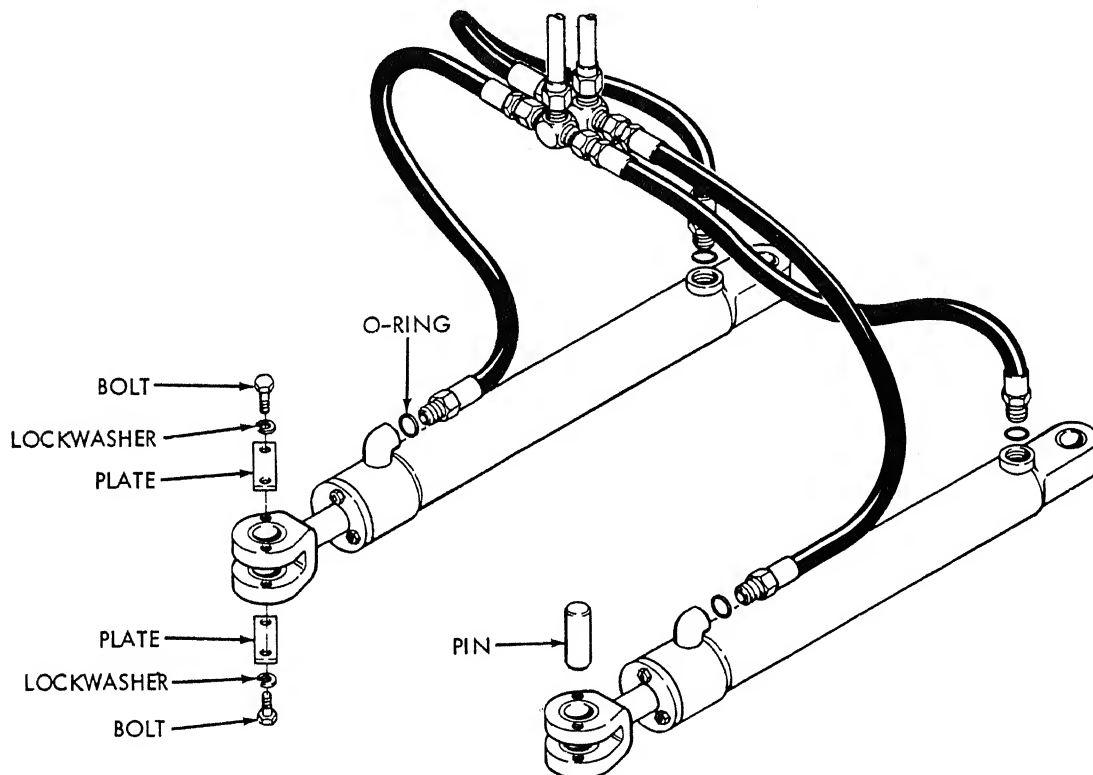
### a. Removal.

- (1) Engage the front chassis safety bar.
- (2) Close the oil valve on the hydraulic reservoir and depressurize the system.
- (3) Steam-clean the cylinder and surrounding area to remove dirt and grease.
- (4) Turn the steering wheel in both directions to relieve pressure in the cylinders.

(5) Disconnect hydraulic hose at rod end, closed end of the cylinder (fig 7-44). Disconnect preformed packings.

*Note.* Cap or plug lines and fittings as soon as they are disconnected.

(6) Support the cylinder and remove four bolts and lockwashers, two steering cylinder pin bolts, and one pin from each end of the cylinder. Remove the cylinder from the loader.



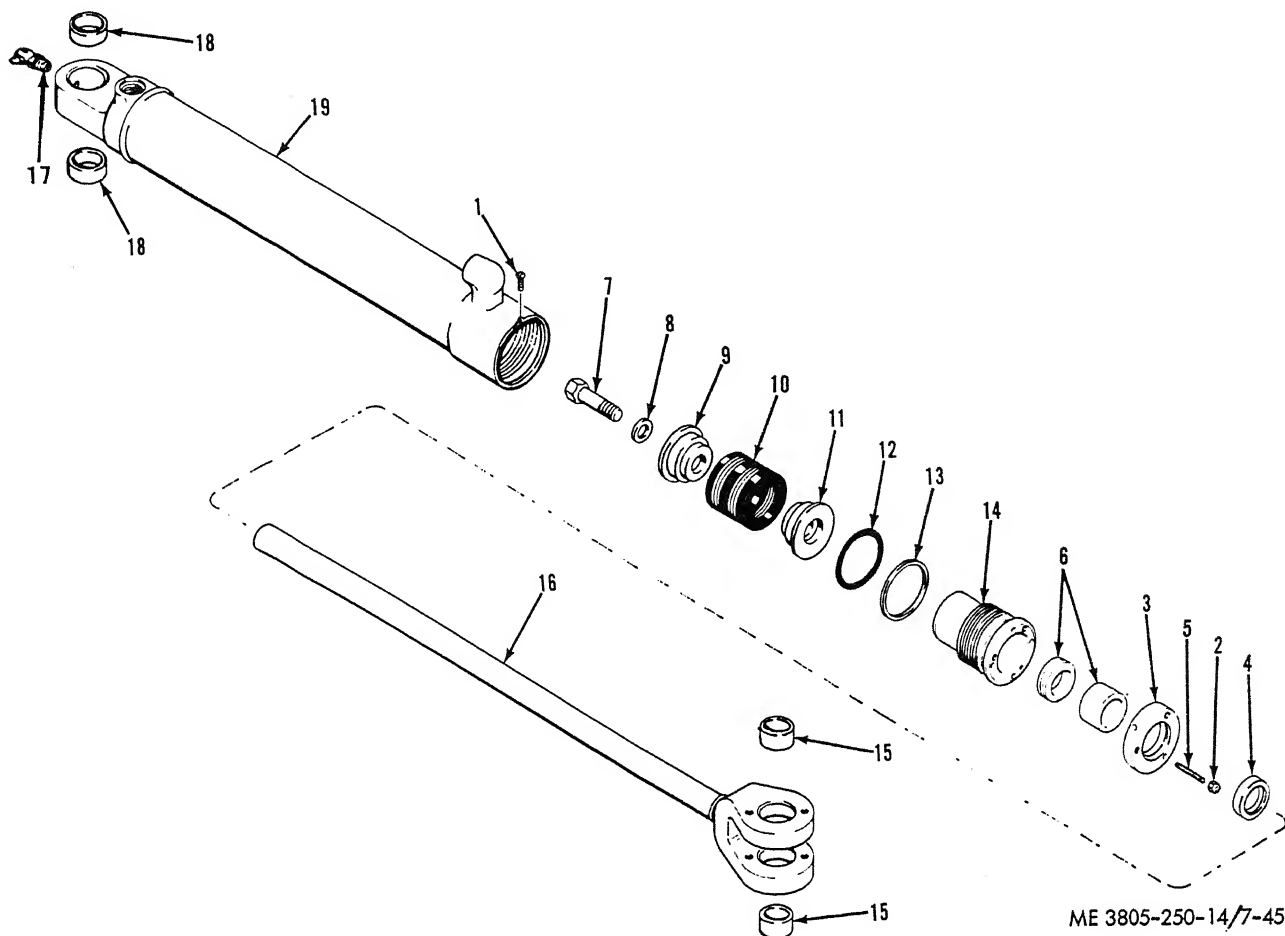
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Figure 7-44. Steering hydraulic cylinder, removal and installation.

### b. Disassembly. Refer to figure 7-45.

(1) Place the cylinder in a vise, using caution not to distort the tube. Remove the self-tapping screw

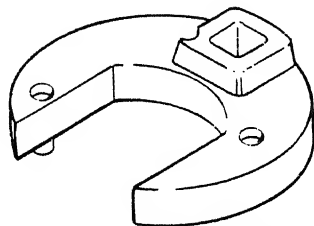
(1). Remove the self-locking nuts (2), flange (3) and seal (4) from the setscrews (5). Remove the setscrews.



- |                      |                       |
|----------------------|-----------------------|
| 1. Screw             | 11. Piston            |
| 2. Nut               | 12. Preformed packing |
| 3. Flange            | 13. Backup ring       |
| 4. Seal              | 14. Gland             |
| 5. Setscrew          | 15. Bushing           |
| 6. Packing assembly  | 16. Rod               |
| 7. Bolt              | 17. Fitting           |
| 8. Washer            | 18. Bushing           |
| 9. Piston            | 19. Tube assembly     |
| 10. Packing assembly |                       |

Figure 7-45. Steering hydraulic cylinder, exploded view.

(2) Using spanner wrench D-44112 (fig. 7-46), unscrew the gland assembly from the tube.



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Figure 7-46. Spanner wrench.

(3) Remove the packing assembly (6 fig 7-45) from the gland.

(4) Carefully slide the piston and gland assemblies from the tube. Do not allow the rod to cock as it is removed; internal parts could be damaged.

(5) Clamp the piston rod eye in a vise and remove the self-locking bolt (7) from the end of the piston rod.

(6) Remove washer (8) from the piston rod. Remove piston (9), packing assembly (10) and piston (11). Remove preformed packing (12) and backup ring (13).

(7) Remove gland (14).

(8) Remove bushings (15) from rod (16). Remove fitting (17) and bushings (18) from the closed end of the tube assembly (19).

*Note.* Do not remove bushings unless they are to be replaced.

#### c. Cleaning, Inspection and Repair.

(1) Clean all components in solvent and dry with compressed air.

(2) Replace packings.

(3) Shine a light in the cylinder tube. Replace if it is deeply grooved or scored or otherwise seriously damaged.

(4) Inspect the piston rod for alignment. If bent, the rod must be replaced. Refer to subparagraph e for rod yoke replacement.

(5) Replace bushings if they are worn or damaged.

(6) Remove any nicks or scratches on the rod or in the cylinder tube with medium grit emery cloth, polishing with a rotary motion.

#### d. Reassembly. Refer to figure 7-45.

(1) If bushings (15 and 18) were removed, press in new bushings.

(2) Assemble the packing assembly (6), flange (3) and seal (4) into the gland.

(3) Lubricate the packing with hydraulic oil, and install the gland assembly onto the rod (16). Install preformed packing (12) and backup ring (13).

(4) Install the piston packing (10) on the piston halves (9 and 11) with the hard end ring toward the flange and the bottom of the chevron toward the piston (fig. 7-47). Place the female adapter between the piston halves. Slide the piston assembly onto the rod with the piston with the deeper counterbore first. Install the washer (8) and self-locking bolt (7), and tighten bolt to 200 to 220 pound-feet.

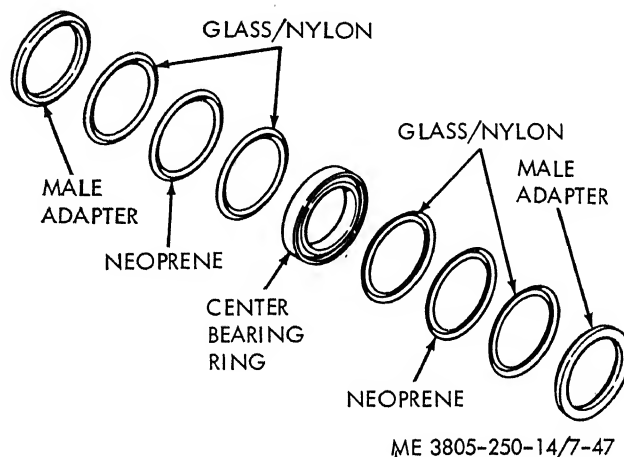


Figure 7-47. Piston packing installation.

(5) Lubricate the cylinder tube and piston assembly and insert the end of the rod into the tube. Slide the gland assembly down the rod and engage the threads with the cylinder threads. Use spanner wrench D-44112, tighten the gland to  $15 \pm 50$  pound-feet and align the holes for the self tapping screw.

*Note.* If a new gland or tube is being installed, use a No. 26 drill to drill a hole through the tube and into the gland. Drill 5/16 inch deep. Do not drill in line with the spanner wrench holes or the gland stud holes.

(6) Insert setscrews (5) into gland (14). Install self-locking nuts (2) and tighten to 50 pound-inches. Continue to tighten nuts in equal increments of 10 pound-inches until all three nuts are tightened to 80 pound-inches. After installation increase torque as necessary to eliminate leakage.

(7) Install grease fitting (17).

#### e. Replacement of Rod Eye and Yoke Assemblies.

(1) Disassemble the cylinder and remove the piston rod.

*Note.* Use care not to damage the piston rod when handling.

(2) Grind all weld from the piston rod, using care not to enlarge the original groove. Protect the rod with tape or a cardboard sleeve while grinding.

(3) Before welding, position the eye assembly as follows:

(a) Center the eye assembly so that the center lines of the eye assembly and the piston rod coincide.

(b) Position the eye assembly so that it is square with the piston rod and not cocked in any direction (fig. 7-48).

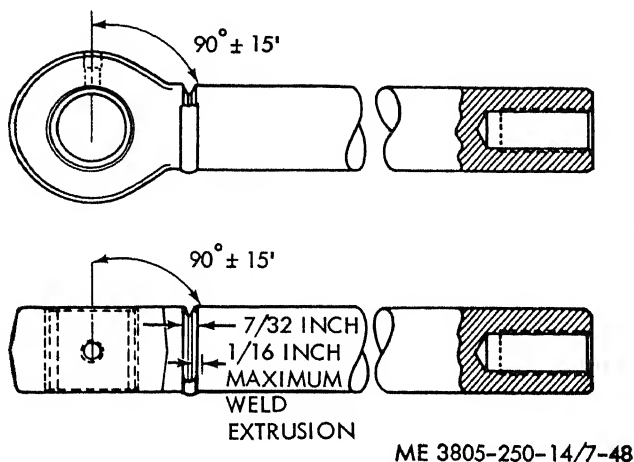


Figure 7-48. Rod eye alignment.

(c) When the eye is properly positioned, tack weld the eye to the piston rod on one side. Use a 1/8-inch low hydrogen rod.

(4) Starting on the side opposite the tack weld, weld the eye to the piston rod. Turn the rod while welding to obtain a two or three pass weld.

(5) Ensure that alignment of step (3) has not changed. Check that the weld does not extend over 1/16 inch back from the groove onto the piston rod.

#### f. Installation.

(1) Install the steering cylinder by reversing the removal procedure.

(2) Add one-half gallon of hydraulic fluid to the reservoir for each cylinder removed.

(3) Start the engine and pressurize the hydraulic system. Turn the steering wheel through several complete cycles to bleed air from the steering cylinders and lines. Check hydraulic system for leaks. Check the hydraulic oil level and add oil as required.

*Note.* If steering cylinders are leaking at the gland end, tighten the three locknuts on the gland until the leakage stops.

## 7-32. Steering Link Assembly

### a. Removal.

(1) Close the air valve at the hydraulic reservoir and depressurize the system.

(2) Remove cotter key, slotted nut, washer, and steering stud securing the link to the pitman arm (fig. 7-49).

(3) Remove cotter key, slotted nut, washer, and steering stud securing the link to the pivot mounting. Remove the link from the loader.

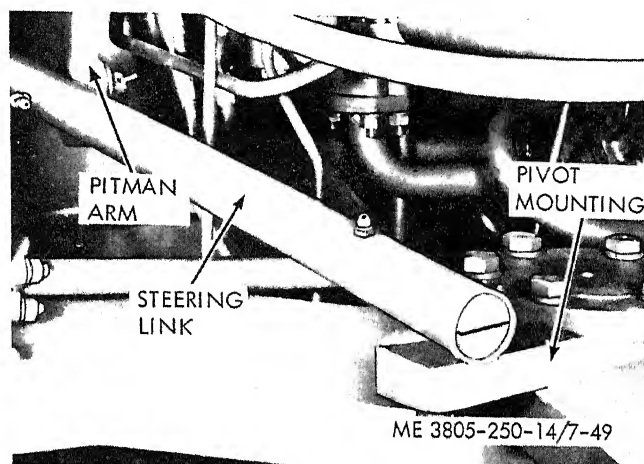
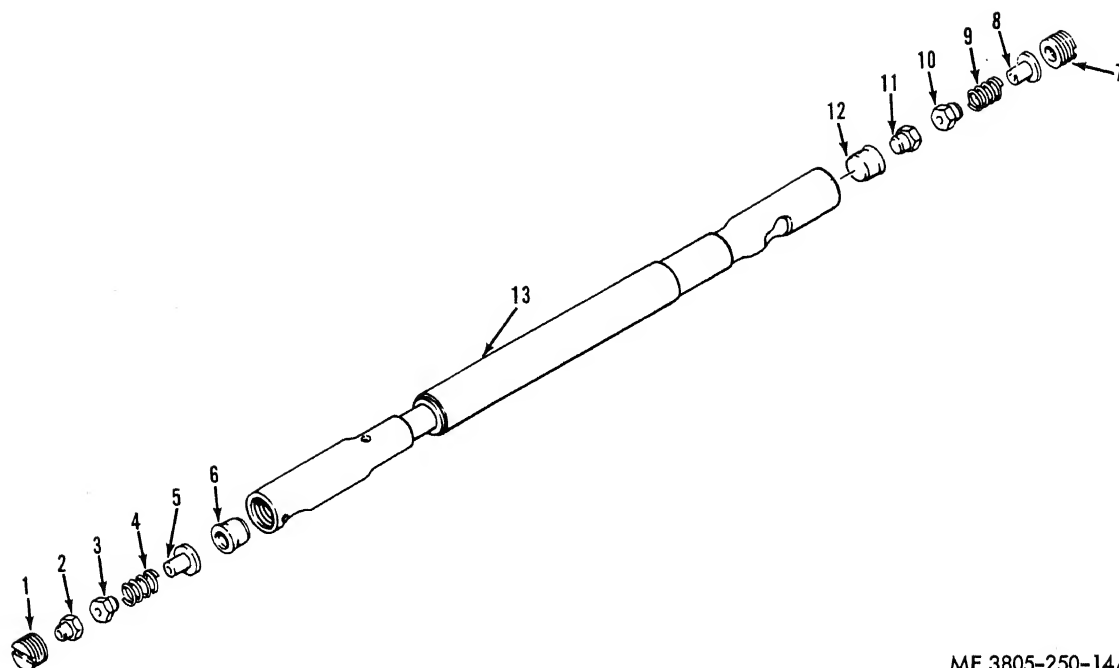


Figure 7-49. Steering link assembly, removal and installation.

### b. Disassembly. Refer to figure 7-50.

(1) Unscrew plug (1), and remove ball retaining seats (2 and 3), spring (4), spring seat (5), and reservoir (6) from the end of the link (13).

(2) Unscrew plug (7), and remove spring seat (8), spring (9), ball retaining seats (10 and 11), and reservoir (12) from the link (13).



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- |              |               |
|--------------|---------------|
| 1. Plug      | 8. Seat       |
| 2. Seat      | 9. Spring     |
| 3. Seat      | 10. Seat      |
| 4. Spring    | 11. Seat      |
| 5. Seat      | 12. Reservoir |
| 6. Reservoir | 13. Link      |
| 7. Plug      |               |

Figure 7-50. Steering link assembly, exploded view.

*c. Cleaning, Inspection and Repair.*

(1) Clean all components with solvent.

(2) Inspect for thread damage. Replace plugs if they are badly damaged.

(3) Inspect ball seats and mating ball studs for cracks, nicks, scratches, scoring, and wear. Remove minor surface damage with abrasive cloth. Replace components which are badly damaged or worn.

(4) Inspect springs for cracks and weak coil. Replace as necessary.

(5) Inspect the link for bends, cracks, and other damage. Straighten bent link. Replace if badly damaged.

(6) Inspect spring seats and reservoirs for cracks, scoring, and other damage. Remove minor surface damage with abrasive cloth. Replace badly damaged components.

*d. Reassembly.* Assemble the steering link by reversing the disassembly procedure.

*e. Installation.* Install steering link by reversing the removal procedure.

## CHAPTER 8

# REPAIR OF ELECTRICAL, HYDRAULIC AND PNEUMATIC COMPONENTS

### Section I. ELECTRICAL COMPONENTS

#### 8-1. General

The loader electrical system supplies power to start the engine and operate the lights, instruments, and warning devices. The system consists basically of batteries, an alternator, alternator regulator, starting motor, and wiring, switches and other electrical components. Refer to figure 1-3 for the wiring diagram.

#### 8-2. Alternator

a. *Removal.* Refer to paragraph 4-30.

b. *Disassembly.*

*Note.* Use Alternator Service Set A200-S (fig. 8-1) to aid in disassembling the alternator.

(1) Place the alternator in a vise with the rear housing up.

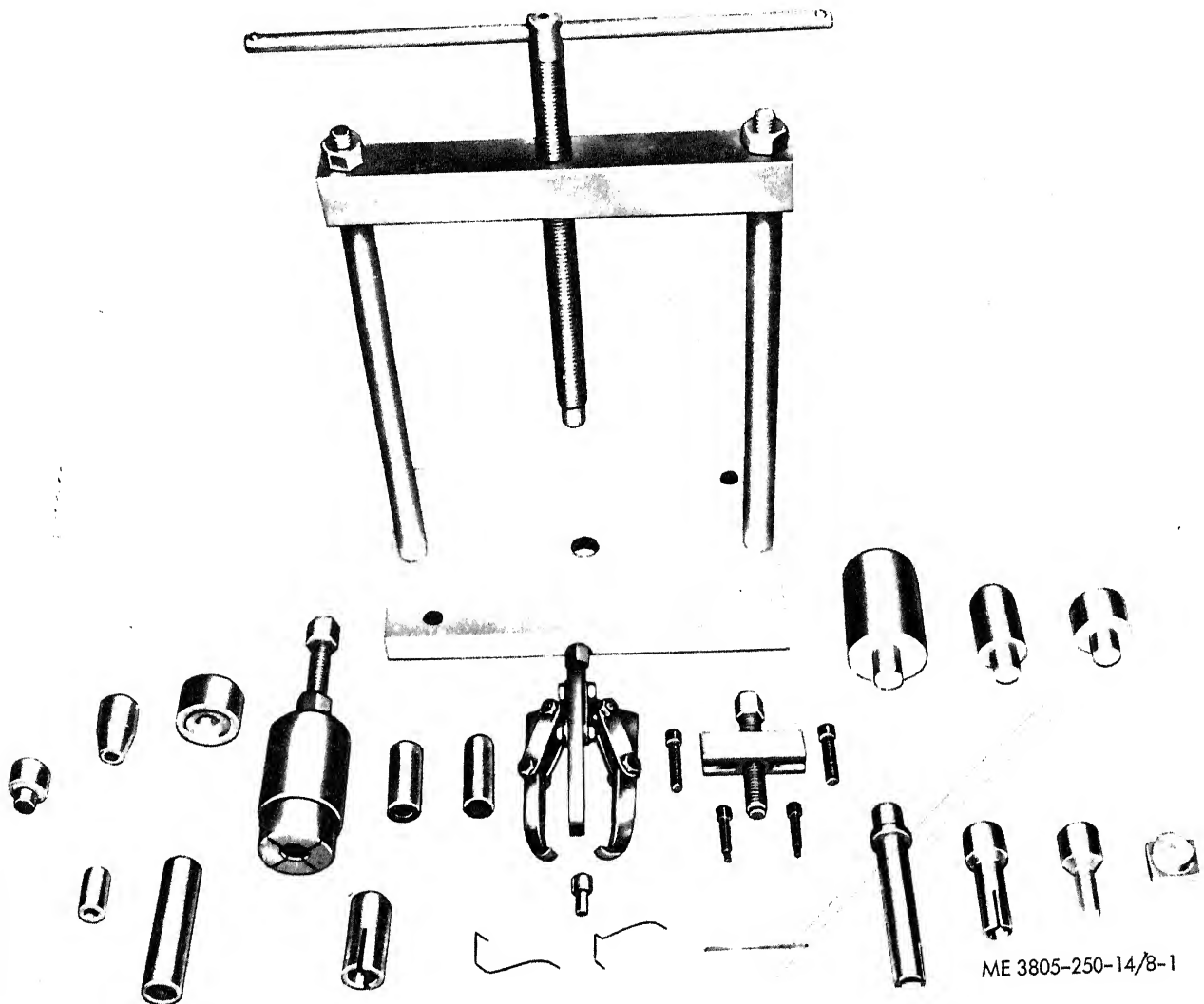


Figure 8-1. Alternator service set A200-S.

(2) Remove two screws (1, fig. 8-2) securing the brush cover (2) to the rear housing (3). Pull the cover out, and remove two brush assembly mounting screws (4). Remove the cover and brush assembly (5) from the rear housing.

(3) Remove nut (6), lockwasher (7), washer (8), screw (9), washer (10) and insulator (11) which form the field terminal. Remove the brush to field terminal wire (12) and the brush insulator (13). Remove gasket (14) from the cover.

(4) Remove the four rear housing bolts (15) and shakeproof washers (16). Separate the rear housing (3) from the drive end housing (17).

**CAUTION: Do not insert the screwdriver blade more than 1/16 inch into the opening.**

(5) Carefully insert screwdriver blades into opposite openings between the stator (18) and drive end housing, and pry them apart.

(6) Attach tool A-216 to the drive end housing (17). Turn the screw on the end of the tool to remove the housing from the rotor (26). Remove the seal (19) if it is to be replaced.

(7) Remove the bearing (20) from the rotor shaft by placing the jaws of tool A-202 under the bearing and turning the tool's forcing screw.

(8) Remove three screws (21), and lockwashers (22), and remove bearing retainer (23), felt washer (24), and bearing sleeve (25) from the rotor (26).

*Note.* Remove the slip ring hub (29) or bearing (3) only when necessary.

(9) Remove the slip ring hub (29) as follows:

**CAUTION: Be careful not to overheat the leads.**

(a) Unsolder the rotor leads from the slip ring terminals and unwind the leads.

(b) Remove the screw (27) and lockwasher (28) from the end of the rotor shaft, and thread a 1/2 inch — 28 x 1 1/2 inch cap screw into the slip ring hub (29). This will back the slip ring hub off the rotor shaft.

(10) Remove the bearing retainer (30) and attach tool A-216 to bearing (31). Turn the tool forcing screw to remove the bearing.

(11) Remove the stator (18) from the rear housing as follows:

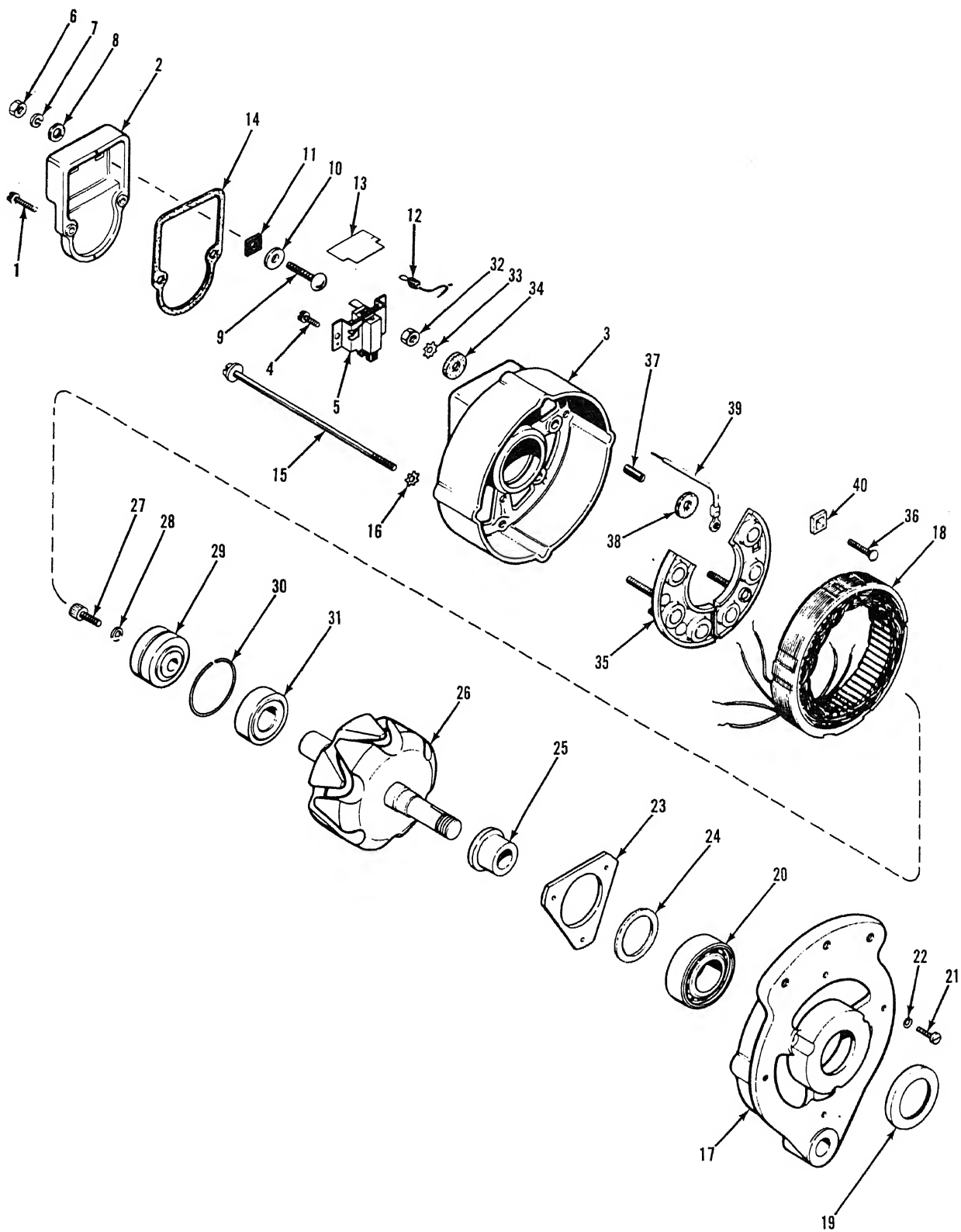
(a) Place the open end of the stator on a clean work surface.

(b) Remove four nuts (32), shakeproof washers (33) and washers (34) from the terminal studs of diode (35) and from the rectifier ring stud (36).

(c) Carefully and evenly tap the terminal studs out of the rear housing (3) and lift the housing. Remove the nylon sleeve (37), washer (38), cable (39) and insulator (40) from the rectifier ring stud.

**KEY to fig. 8-2:**

1. Screw	21. Screw
2. Brush cover	22. Lockwasher
3. Rear housing	23. Bearing retainer
4. Screw	24. Felt washer
5. Brush assembly	25. Sleeve
6. Nut	26. Rotor
7. Lockwasher	27. Screw
8. Washer	28. Lockwasher
9. Screw	29. Slip ring hub
10. Washer	30. Bearing retainer
11. Insulator	31. Bearing
12. Wire	32. Nut
13. Insulator	33. Shakeproof washer
14. Gasket	34. Washer
15. Bolt	35. Diode
16. Shakeproof washer	36. Ring stud
17. Drive end housing	37. Sleeve
18. Stator	38. Washer
19. Seal	39. Cable
20. Bearing	40. Insulator



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Figure 8-2. Alternator, exploded view.



*c. Cleaning, Inspection and Repair.*

- (1) Clean all components with a clean, dry cloth.
  - (2) Inspect the front and rear housings for cracks and other defects.
  - (3) Inspect the rotor and stator windings for defective and discolored insulation. If discoloring is present, check for shorted windings and replace or repair as necessary.
  - (4) Inspect brushes for wear and oil contamination, and replace as necessary.
  - (5) Check brush spring tension.
  - (6) Clean contact surface on the slip ring with crocus cloth.
  - (7) Check bearings for free rotation and flat spots and replace as necessary.
  - (8) Replace any cracked insulation.
  - (9) Check diodes for security.
  - (10) Replace all gaskets and seals.
- d. Reassembly. Refer to figure 8-2.*

*Note.* Refer to figure 8-1 for Alternator Service Set tools required for assembling the alternator.

(1) Position the front bearing retainer (23) and felt washer (24) on the shaft of rotor (26). Press the bearing sleeve (25) onto the shaft.

(2) Install tool A-208 in the base of Alternator Press A-201, and install tool A-205 in tool A-208. Install tool A-209 on the tip of the forcing screw on the Alternator Press. Support the rotor (26) on tool A-205, and place the drive end housing (17) and bearing (20) in position on the rotor. Turn the press's forcing screw until the bearing reaches the stop on the rotor shaft.

(3) Install a new seal (19) in the drive end housing. Secure the bearing retainer (23) to the front housing with three screws (21) and lockwashers (22).

(4) To install the rear bearing (31) on the rotor (25), place tool A-208 in the base of Alternator press A-201, and install tool A-206 on the tip of the press's forcing screw. Support the drive end housing (17) and rotor (26) on tool A-208, and position bearing (31) on the rotor. Turn the press's

forcing screw until the bearing bottoms against the shoulder on the rotor shaft.

(5) To install the slip ring hub (29), guide the rotor leads through the square passage in the slip ring. Hand press the slip ring hub onto the rotor shaft while maintaining alignment of the rotor lead and passage.

(6) Install the bearing retainer (30) in the rear housing (3).

(7) Install screw (27) and lockwasher (28) in the rotor shaft, and tighten screw to 45 pound-inches.

(8) Place the stator (18) on a clean workbench, diode side up. Position ring stud (36) insulator (40), cable (39), washer (38) and sleeve (37) on the diode.

(9) Place the rear housing (3) over the stator. Secure the stator and diode assemblies to the housing with four nuts (32), shakeproof washers (33) and washers (34). Tighten the nuts to 20 to 30 pound-inches.

(10) Join the rear housing and drive end housing so that the mounting foot is opposite the brush cover.

Secure with four rear housing bolts (15) and shakeproof washers (16), and tighten to a torque of 50 to 60 pound-inches. Spin the rotor and check for binding.

(8) Place the brush assembly (5) on the rear housing and secure with two screws (4). Tighten to a torque of 16 to 20 pound-inches.

(9) Install screw (9), washer (10), insulator (11), washer (8), lockwasher (7) and nuts (6) on brush cover (2) to form field terminal. Install new gasket (14). Position brush insulator (13) and install the cover. Secure with two screws (1), and tighten to a torque of 20 to 30 pound-inches.

*e. Installation.* Refer to paragraph 4-30.

*f. Brush Replacement.*

(1) With the alternator removed from the loader or with the alternator installed in the loader and wiring disconnected, remove two screws (fig. 8) securing the brush cover to the alternator rear housing. Pull out the cover and remove two brush assembly mounting screws. Remove the cover and brush assembly from the rear housing.

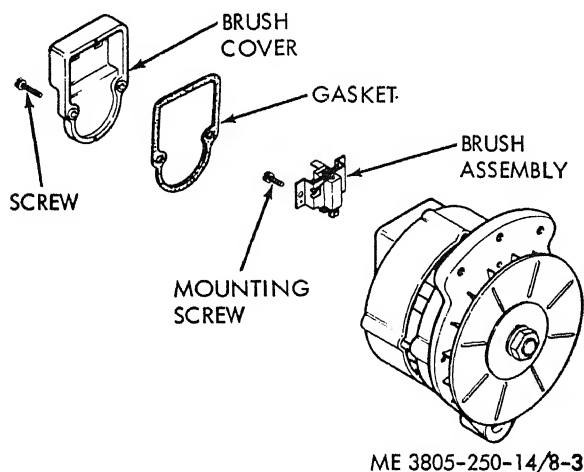


Figure 8-3. Alternator brush replacement.

(2) Install new brushes and secure with two mounting screws.

(3) Place a new gasket on the brush cover and secure the cover to the rear housing with two screws.

(4) Connect wiring or install the alternator in the loader.

### 8-3. Starter Motor

a. *Removal.* Refer to paragraph 4-32.

b. *Disassembly.* Refer to figure 8-4

(1) Remove two terminal stud nuts (1), two lockwashers (2), one washer (3) and insulator (4).

(2) Remove oil reservoir hole plug (5), gasket (6) and felt plug (7).

(3) Remove oil wick hole plug (8) and wick (9).

(4) Remove four bolts (10) and lockwashers (11) securing commutator end (12) to the housing and remove the commutator end.

(5) Remove three spacer mounting ring bolts (13) and lockwashers (14).

(6) Remove bushing (15) and pretormed packing (16).

(7) Remove the two brush plate assemblies from the housing.

(8) Remove two brush spring carrier studs (17) and brush springs (18).

(9) Remove two screws (19) and four lockwashers (20) securing each of the two starter brush

holders (21), spacers (22) and, on the insulated brush, plate (23) to the brush mounting ring (24).

(10) Remove two screws (25) and lockwashers (26) securing each of four brushes (27) to the brush holders (21).

(11) Remove the terminal and plate assembly (28), insulator (29), and two terminal stud washers (30).

(12) Remove eight screws (31) connecting the pole shoes (32) in position and remove the four shoes and two junction insulators (33).

(13) Remove two nuts (34) and lockwashers (35) securing the solenoid (36) to the connector (37), and two nuts (38) and lockwashers (39) securing the connector to the starter housing (40).

(14) Remove the four solenoid mounting screws (41), and remove the terminal switch wire (42). Remove the solenoid and disassemble as instructed in subparagraph c.

(15) Remove nut (43), washer (44), two outer insulators (45), bolt (46) and inner insulators (47).

(16) Slide the starter armature (48), coil (49) and coil insulator (50) from the housing. Remove washer (51) and spacer (52).

(17) Remove snap ring (53), preformed packing (54), stud (55) and preformed packing (56).

(18) Remove the plunger assembly from the housing. Remove nut (57) and retaining ring (58), and remove spring seat (59), spring (60), seat (61), boot (62) and seat (63) from the plunger (64).

(19) Remove five bolts (65) and lockwashers (66), and remove the shift lever housing (67) from the starter housing.

(20) Remove the expansion plug (68), housing plug (69), pipe plug (70), and oil wick (71).

(21) Remove plug (72) and gasket (73).

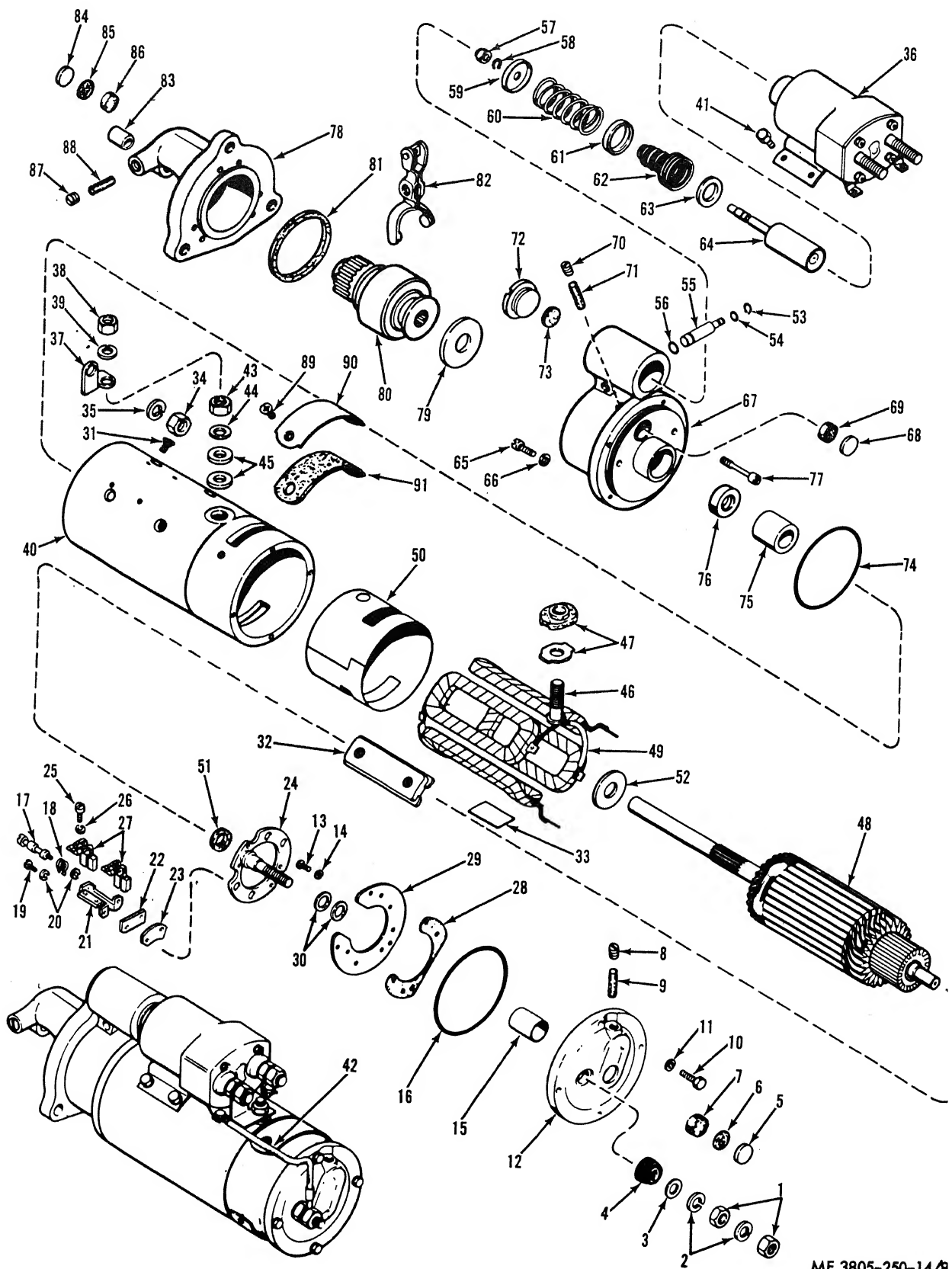
(22) Remove preformed packing (74), bushing (75) and oil seal (76).

(23) Remove the drive end attaching screws (77) and remove the drive end housing (78) from the shift lever housing (67).

(24) Remove the brake washer (79), drive assembly (80), gasket (81), and shift lever (82).

(25) Remove bushing (83), expansion plug (84), gasket (85), felt plug (86), wick plug (87) and wick (88) from the drive end housing.

(26) Remove four inspection cover retaining screws (89) and remove inspection cover (90) and gasket (91) from starter housing.



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Figure 8-4. Starter, exploded view.

**KEY to fig. 8-4:**

- |                                 |                          |                         |
|---------------------------------|--------------------------|-------------------------|
| 1. Terminal stud nut            | 31. Screw                | 62. Boot                |
| 2. Lockwasher                   | 32. Pole shoe            | 63. Seat                |
| 3. Washer                       | 33. Junction insulator   | 64. Plunger             |
| 4. Insulator                    | 34. Nut                  | 65. Bolt                |
| 5. Plug                         | 35. Lockwasher           | 66. Lockwasher          |
| 6. Gasket                       | 36. Solenoid             | 67. Shift lever housing |
| 7. Felt plug                    | 37. Connector            | 68. Expansion plug      |
| 8. Plug                         | 38. Nut                  | 69. Housing plug        |
| 9. Wick                         | 39. Lockwasher           | 70. Pipe plug           |
| 10. Bolt                        | 40. Starter housing      | 71. Oil wick            |
| 11. Lockwasher                  | 41. Mounting screw       | 72. Plug                |
| 12. Commutator end              | 42. Terminal switch wire | 73. Gasket              |
| 13. Bolt                        | 43. Nut                  | 74. Preformed packing   |
| 14. Lockwasher                  | 44. Washer               | 75. Bushing             |
| 15. Bushing                     | 45. Outer insulator      | 76. Oil seal            |
| 16. Preformed packing           | 46. Bolt                 | 77. Screw               |
| 17. Stud                        | 47. Inner insulator      | 78. Drive end housing   |
| 18. Brush spring                | 48. Armature             | 79. Brake washer        |
| 19. Screw                       | 49. Coil                 | 80. Drive assembly      |
| 20. Lockwasher                  | 50. Coil insulator       | 81. Gasket              |
| 21. Brush holder                | 51. Washer               | 82. Shift lever         |
| 22. Spacer                      | 52. Spacer               | 83. Bushing             |
| 23. Plate                       | 53. Snap ring            | 84. Expansion plug      |
| 24. Mounting ring               | 54. Preformed packing    | 85. Gasket              |
| 25. Screw                       | 55. Stud                 | 86. Felt plug           |
| 26. Lockwasher                  | 56. Preformed packing    | 87. Wick plug           |
| 27. Brush                       | 57. Nut                  | 88. Wick                |
| 28. Terminal and plate assembly | 58. Retaining ring       | 89. Retaining screw     |
| 29. Insulator                   | 59. Seat                 | 90. Inspection cover    |
| 30. Washer                      | 60. Spring               | 91. Gasket              |
|                                 | 61. Seat                 |                         |

**c. Solenoid Disassembly.** Refer to figure 8-5.

(1) Remove the terminal stud nut (1) and lock washer (2) from the battery terminal stud (3).

*Note.* The nut and lockwasher on the motor terminal stud (4) were removed when the switch was taken from the starter.

(2) Remove nut (5), lockwasher (6), washer (7), outside bushing (8) and inside bushing (9) from each terminal stud.

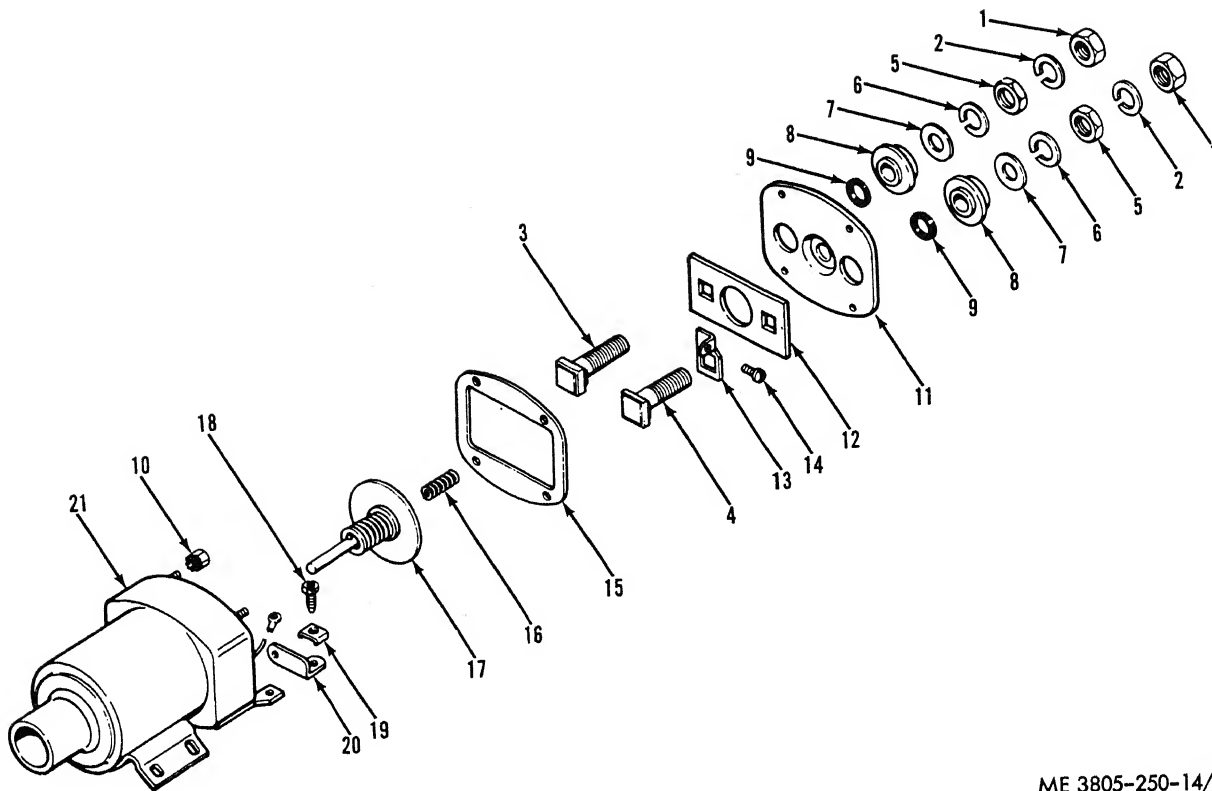
(3) Disconnect four nut and washer assemblies (10) securing the terminal plate (11) to the switch

housing. Remove the terminal plate, plate insulator (12) and battery and starter terminal studs. Remove the coil lead support (13) and screw (14).

(4) Remove gasket (15) from the face of the housing (21).

(5) Take the spring (16) and contact disc (17) from the starter housing.

(6) On the starter terminal side, disconnect screw (18), terminal clip (19) and ground connector (20).



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- |                          |                             |                      |
|--------------------------|-----------------------------|----------------------|
| 1. Nut                   | 8. Outside bushing          | 15. Gasket           |
| 2. Lockwasher            | 9. Inside bushing           | 16. Spring           |
| 3. Battery terminal stud | 10. Nut and washer assembly | 17. Contact disc     |
| 4. Motor terminal stud   | 11. Terminal plate          | 18. Screw            |
| 5. Nut                   | 12. Plate insulator         | 19. Terminal clip    |
| 6. Lockwasher            | 13. Coil lead support       | 20. Ground connector |
| 7. Washer                | 14. Screw                   | 21. Housing          |

Figure 8-5. Solenoid, exploded view.

#### d. Cleaning, Inspection and Repair.

(1) Inspect insulation for burns, chars and cracks and terminal insulation for loose connections.

(2) Inspect commutator for dirt, wear, burns and glazes.

(3) Inspect armature core laminations for bruises.

(4) Inspect armature shaft, bushings and bearings for wear, and replace as necessary.

(5) Inspect pole shoes for looseness and improper installation.

(6) Perform the armature ground and short tests (subpara g).

(7) Check for thrown solder.

(8) Check for loose commutator bars.

(9) Inspect brushes for bent holders, broken holder springs, and for wear, oil and dirt.

(10) Replace all preformed packings and gaskets.

#### e. Reassembly. Refer to figure 8-4.

(1) Position new gasket (81) on face of drive end housing (78). Insert drive assembly (80) into housing.

(2) Prepare armature (48) for installation by slipping the rod arm through spacer (52), bushing (75), oil seal (76), shift lever housing (67) and brake washer (79).

(3) Position the shift lever (82) in its housing. Install new preformed packings (54 and 55) on shift lever stud (55), and secure the shift lever with the stud. Install snap ring (53).

(4) Insert the armature rod into the motor end of the stator drive assembly (80), carefully fitting the shift lever housing (67) against the drive end

housing. Secure the two housings with the drive end attaching screws (77) as required.

(5) Install the expansion plug (68) and housing plug (69) into the shift lever housing.

(6) Position the four starter pole shoes (32) in the starter housing (40) and secure with eight screws (31).

(7) Install a new preformed packing (74) on the face of the shift lever housing. Slide the starter housing over the armature until the housing rests against the shift lever housing. Secure the housings together with five bolts (65) and lockwashers (66).

(8) Insert the coil assembly (49) and coil insulator (50) into the starter housing. Position the junction insulators (33).

(9) Install bolt (46), inner insulators (47), outer insulators (45), washer (44) and nut (43) to housing. Position connector (37) and secure with nut (38) and lockwasher (39).

(10) Assemble brush plate assemblies and brushes as follows:

(a) Position plate (23), insulated brush only, spacer (22), and brush holder (21) on the brush mounting ring (24) and secure with screw (19) and lockwasher (20).

(b) Secure the brushes (27) to the brush holders with screws (25) and lockwashers (26).

(11) Install new preformed packing (16) on commutator end (12), and position terminal and plate assembly (28) and brush plate insulator (29).

(12) Install three bolts (13) and lockwashers (14).

(13) Position two washers (30) on mounting ring (24) and place washer (51) on armature commutator end. Install the mounting ring assembly in housing.

(14) Install the bushing (15) in the commutator end (12) and place commutator end against the housing. Secure with four bolts (10) and lockwashers (11).

(15) Reassemble solenoid as instructed in subparagraph *f* and position it on the starter housing. Secure to connector (37) with a nut (34)

and lockwasher (35). Secure to housing with four mounting screws (41). Connect cable (42).

(16) Install insulator (4), washer (3), lockwashers (2) and terminal studs (1) to commutator end, securing cable (42).

(17) Install wick (9), plug (8), felt plug (7), gasket (6) and plug (5) to commutator end.

(18) Install wick (88), wick (87), bushing (83), felt plug (86), gasket (85), and expansion plug (84) to drive end (78).

(19) Install gasket (73), plug (72), oil wick (71), and pipe plug (70) to shift lever housing (67).

(20) Position the two inspection covers (90) and gaskets (91) on starter housing and secure each with two retaining screws (89).

*f. Solenoid Reassembly.* Refer to figure 8-5.

(1) Position terminal clip (19) over the ground connector (20) on the motor terminal side and secure with screw (18).

(2) Install a new gasket (15) to the housing face.

(3) Insert the contact disc (17) and spring (16) into the switch housing.

(4) Position the coil lead support (13) on the motor terminal stud (4) and install screw (14).

(5) Insert the battery terminal stud (3) and starter terminal stud (4) through the openings in the plate insulator (12) and terminal plate (11). Install inside bushing (9), outside bushing (8), washer (7), lockwasher (6) and nut (5) to each stud and lockwasher (2) and nut (1) to battery terminal stud.

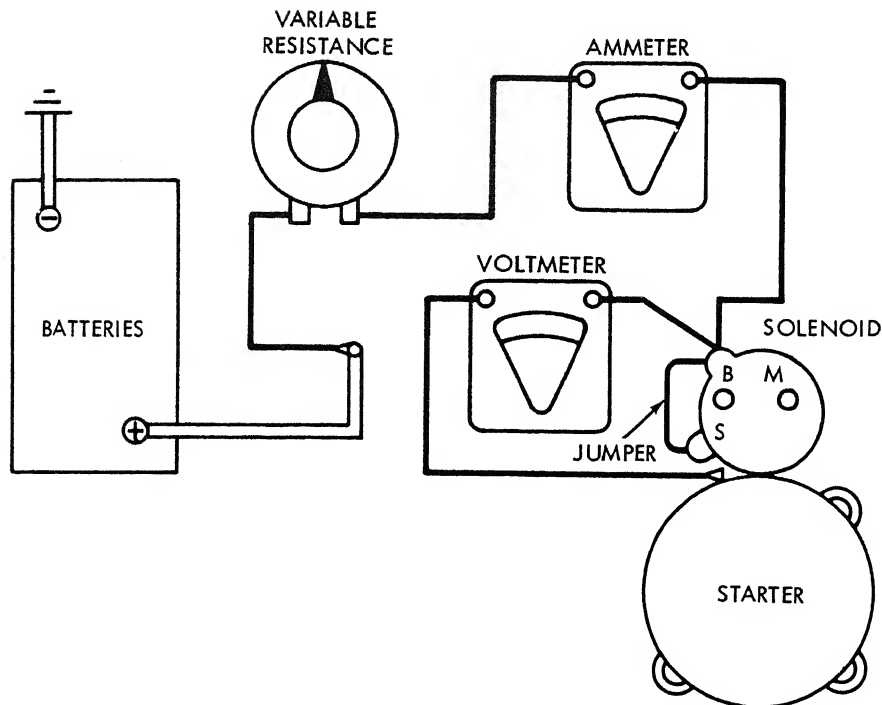
(6) Secure terminal plate (11) to the switch housing with four nut and lockwasher assemblies (10).

*g. Starter Testing.*

(1) *Solenoid test.*

*Note.* The solenoid can be tested on or off the starter motor. If the solenoid is tested while on the starter motor, disconnect the lead from the solenoid motor terminal. Also disconnect the two wires from the solenoid to the auxiliary solenoid.

(a) Connect test setup shown in figure 8-6.



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Figure 8-6. Solenoid test setup.

(b) Adjust the voltmeter indication to 20 volts by means of the variable resistance. Ammeter indication should be 46.1 to 52.3 amps.

(c) Disconnect the solenoid jumper lead.

(d) Adjust the variable resistance as necessary to obtain the 20-volt indication. Ammeter indication should be 6.1 to 6.8 amps.

(e) If ammeter readings do not meet requirements, replace or repair the solenoid.

(2) **Starter testing.** Conduct the following tests using 6625-857-9163 (40-215) growler (fig. 8-7). Tests (a), (b) and (c) are performed on the armature when it is removed from the starter. Test (d) is performed on the starter assembly. Test (e) is performed on the coil.

(a) **Armature ground test.**

1. Place the armature on the growler and turn on power.

2. Touch one test probe to the armature core and the other probe to the commutator. If the test lamp glows, the armature winding or commutator is grounded.

(b) **Armature short test.**

1. Hold the steel blade provided with the

growler parallel with the touching the armature core segment.

2. Slowly rotate the armature one or more revolutions. If the armature is shorted, the steel blade will vibrate.

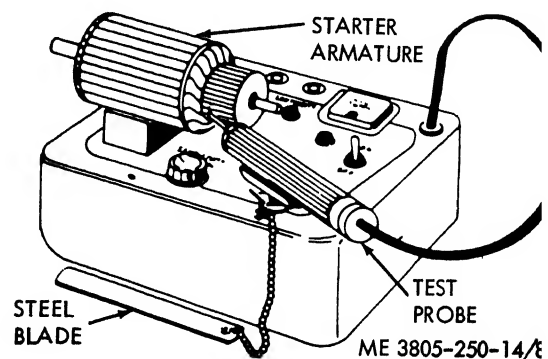


Figure 8-7. Starter tester growler.

*(c) Armature coil balance test.*

1. Follow the directions provided with the growler. Test the commutator bars for abnormal readings which indicate shorted or open connections.

2. If readings are uniform, the commutator is satisfactory.

*(d) Field coil ground test.*

1. Disconnect all field circuit leads connected to the starter housing and brush holders.

2. Touch one test probe to starter housing and the other probe to each field lead, brush holder, and terminal in turn. If the test light illuminates, the part being tested is grounded.

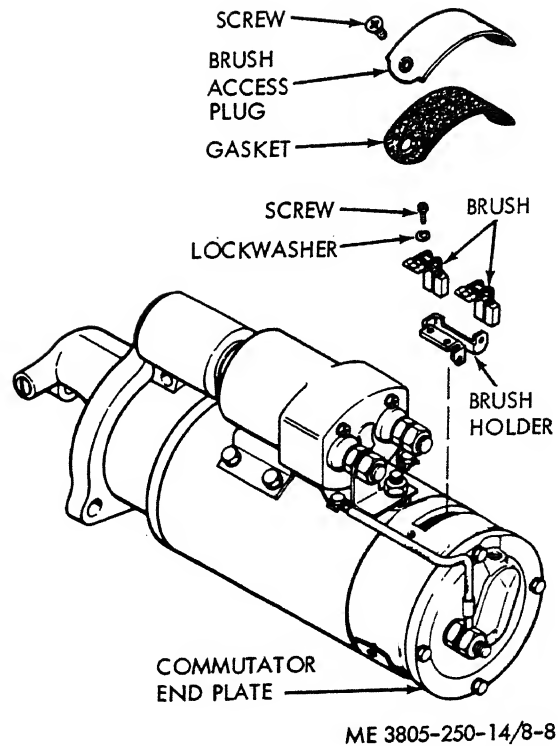
*(e) Field coil continuity test.* Touch the test probes to each end of the field coil windings. If the test lamp does not light, the field coils are open.

*h. Installation.* Refer to paragraph 4-32.

*i. Brush Replacement.*

(1) Remove the brush access plug (fig. 8-8) and disconnect the field winding leads from the brush holder. Tag leads for proper installation.

(2) Remove four screws and lockwashers securing the commutator end plate to the starter housing. Discard the gasket.



*Figure 8-8. Starter brush replacement.*



(3) Remove eight screws and four washers securing the brushes to the brush holders.

(4) Position new brushes on the brush holders and secure with four washers and eight screws.

(5) Cover the commutator with fine sandpaper and hold in place with tape. Slide the commutator end plate onto the starter housing.

(6) Seat the brushes by rotating them over the sandpaper. Remove the sandpaper, and clean the commutator and brush holders.

(7) Install a new gasket in the cover and secure the cover to the housing with four screws and lock-washers.

(8) Connect the field lead to its terminal and install the brush access plug.

#### 8-4. Warning Devices

a. *Removal.* Refer to paragraph 4-38.

#### b. *Repair.*

(1) Inspect switch and buzzer wiring for shorts, broken or loose connections, strip insulation and corroded terminals. Repair or replace as necessary.

(2) Inspect buzzer housings for damage, corrosion or wear which would affect performance.

(3) Replace broken switches or buzzers.

c. *Installation.* Refer to paragraph 4-38.

#### 8-5. Chassis Wiring Harness.

Replace defective wiring harness. Disconnect battery ground cable and separate the front and rear harness sections. Disconnect wiring from all electrical components. Install new or repaired harness.

## Section II. HYDRAULIC COMPONENTS

#### 8-6. General

The hydraulic system supplies fluid to operate the lift and steering systems. The supply system consists basically of an oil reservoir, hydraulic pump, oil cooler, and lines and controls. Refer to figure 1-4 for a schematic diagram of the hydraulic system.

#### 8-7. Testing

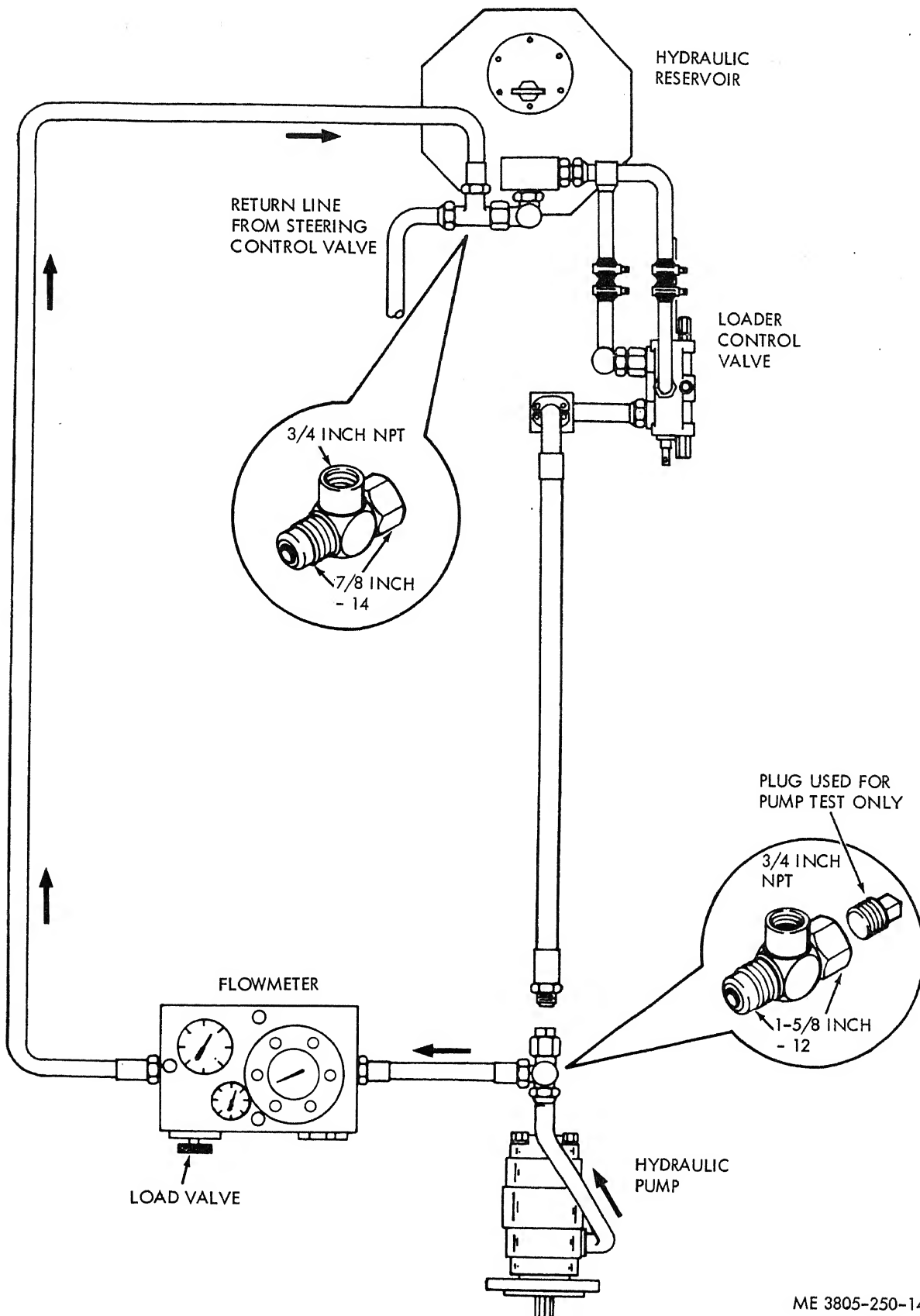
a. *Pump Test.* Perform the pump test to determine if a pump is operating satisfactorily.

(1) Connect a H560-3 (M20270) flowmeter into the hydraulic system as follows. Refer to figure 8-9.

(a) Disconnect the line between the control valve and pump at the mounting bracket at the front end of the pump.

(b) Plug one end of the 1½ — 12 inch tee fitting and install as shown in figure 8-9.

(c) Join the flowmeter pressure line to the tee fitting.



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Figure 8-9. Hydraulic section test setup.

(d) Disconnect the return line on the rear of the block fitting as shown in figure 8-10.

*Note.* Install a tachometer on the engine block to monitor engine speed.

(2) Start the engine and run at high idle (2200 rpm). Heat the oil by closing the flowmeter load valve until pressure reaches 1000 psi. Run the engine until the oil temperature reaches 125° F.

(3) With the engine running at high idle, record the no load flow reading (measured in gallons per minutes). Specification flow rate is 48 gpm.

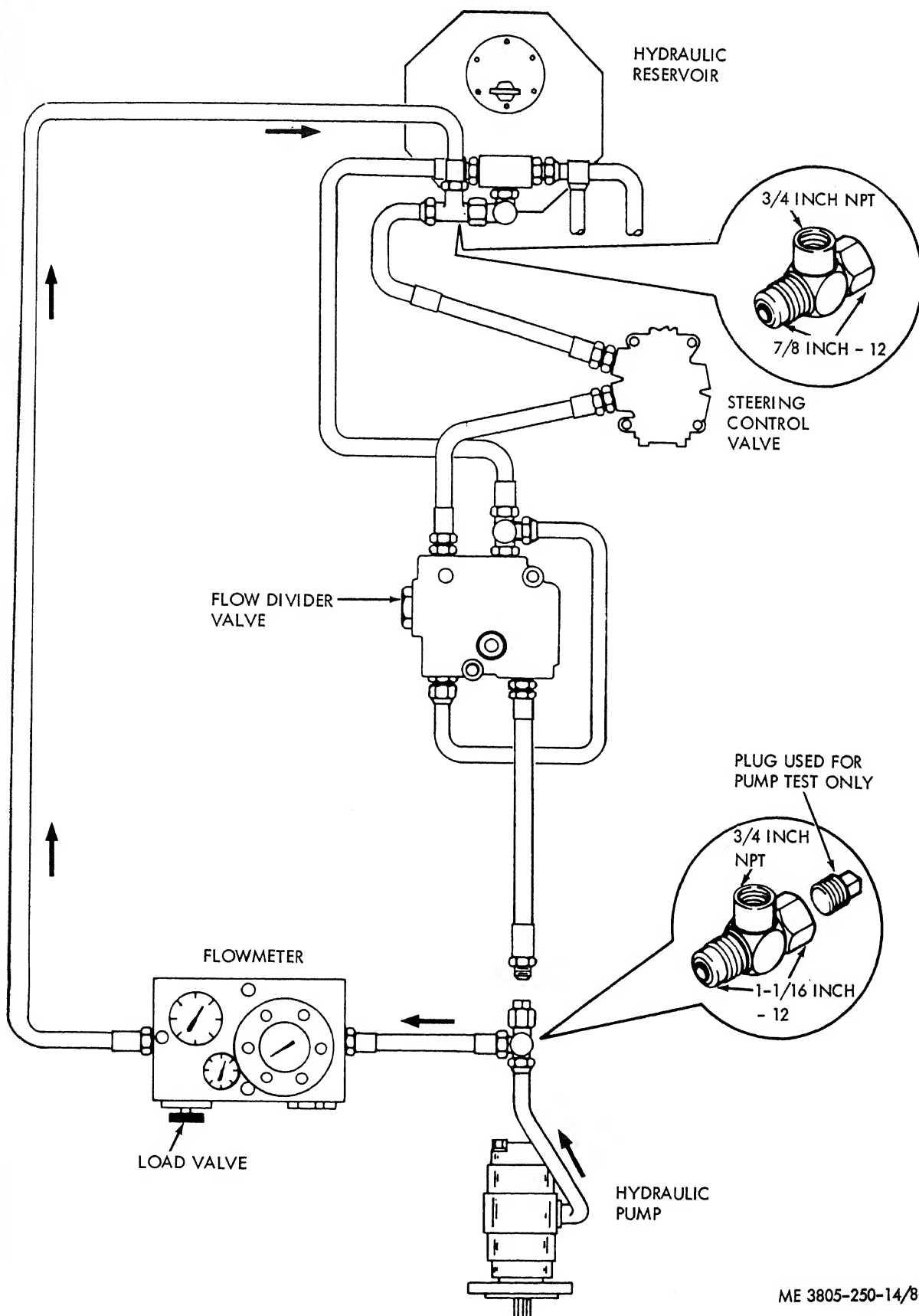
**CAUTION:** The hydraulic system relief valve is bypassed in this test. Ensure

that the load valve is open before starting the test. Close the load valve slowly. The test is conducted at a maximum pressure of 1800 psi. Never exceed the relief valve setting of 2100 psi. Limit test time at high pressures to 30 seconds.

(4) With the engine running at high idle, gradually apply a load by closing the load valve. Correct the engine as necessary to maintain speed. Record flow readings at 1000, 1500, and 1800 psi.

(5) Remove the 7/8-14 inch tee fitting and cap. Reconnect the hose and tube.

(6) Disconnect the line between the steel relief valve and the pump. Install as shown in figure 8-10.



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Figure 8-10. Steering section test setup.

(7) With the engine running at high idle, take the no load flow reading. Specification flow reading is 24 gpm.

(8) Gradually apply a load by closing the load valve. Correct engine speed as necessary to maintain speed. Record flow reading at 1000, 1500, and 1800 psi.

(9) If free flow readings taken in steps 3 and 7 are less than 90 percent of specification, check for restrictions or air leaks caused by loose fittings in the inlet line.

(10) The decrease in flow rates with an increase in load (steps 4 and 8) indicates the degree of pump wear. A satisfactory pump produces a flow rate of at least 80 percent of specification value at higher pressures.

*b. Tee Test.* If the pump test indicates that the pump is satisfactory, perform the tee test to locate trouble spots in cylinders and control valves.

(1) Connect the flowmeter as shown in figure 8-9. Do not plug the  $1\frac{1}{8}$ -12 inch tee.

(2) Check the oil temperature. If necessary, run the engine to heat the oil to 125° F.

(3) Test the pressure setting of the loader main relief valve as follows:

(a) Ensure that the load valve is fully open.

(b) Place the flowmeter volume range selector in high range.

(c) Run the engine at 2200 rpm. Maintain engine speed throughout the tests.

*Note.* Install a tachometer on the engine block to monitor engine speed.

(d) Completely retract the bucket and gradually close the load valve with the control lever held in the power position. The cracking point for the main relief valve is the pressure at which the flowmeter pressure gage begins to drop. Record this reading.

(e) Continue to close the load valve. The main relief valve setting is the pressure at which the flowmeter pressure gage indicates zero. Record this reading.

(f) The reading obtained in (e) should be 1900 to 2100 psi. Reading obtained in (d) should be with 10 percent of the reading of (e). If necessary, adjust the main relief valve setting as described in paragraph 8-12.

(4) Test the tilt cylinder circuits as follows:

(a) Completely dump the bucket.

(b) Partially close the load valve until the flowmeter pressure gage indicates 1800 psi.

(c) Completely retract the bucket and record the flow rate at 1800 psi.

(5) Repeat step (4) for the lift and cylinders.

(6) The recorded flow readings for each cylinder at 1800 psi should agree closely with the pump flow reading at 1800 psi recorded in the pump test, above.

(7) If the flow readings for one or more cylinders are below the pump flow reading in both the extended and retracted positions, check for a leak past the cylinder packing in one or more cylinders. If the flow rate is low in only one cylinder position, check for a leak in the spool.

(8) If all cylinder flow readings are low, check for a leak before it reaches the cylinders. Check the main relief valve seals and check valve cartridge O-rings for damage.

## 8-8. Hydraulic Pump

### *a. Removal.*

(1) Close the air valve on the hydraulic reservoir and slowly loosen the reservoir filler cap to depressurize the reservoir. Remove the drain plug and drain the reservoir.

(2) Work the control levers back and forth to relieve oil pressure in the lines and pump.

(3) Ensure that the pump and surrounding area are clean.

(4) Remove four bolts (1, fig. 8-11) and lockwashers (2) securing the loader circuit pressure line (3). Discard preformed packing (4).

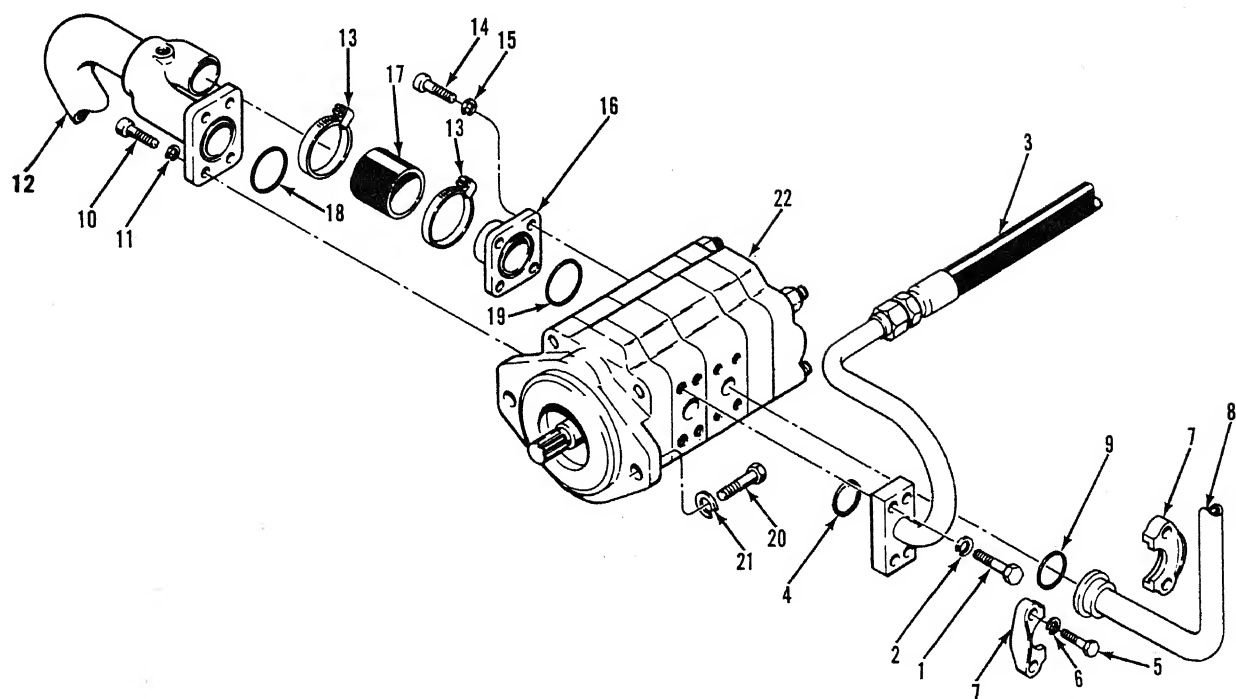
*Note.* Cap or plug lines and fittings as soon as they are disconnected.

(5) Remove four bolts (5) and lockwashers (6) holding the split flange (7) in place. Remove the flange and disconnect the steering line (8). Discard preformed packing (9).

(6) Remove four bolts (10) and lockwashers (11) securing the inlet tube (12). Loosen hose clamps (13) and remove four bolts (14) and lockwashers (15) securing the tube flange (16). Remove the inlet tube (12) and low pressure hose (17). Discard preformed packings (18 and 19).

(7) Push aside or remove hydraulic lines as required for pump removal.

(8) Support the pump and remove two bolts (20) and lockwashers (21) securing the pump to the bracket on the torque converter housing. Then remove the pump from the loader.



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- |                                 |                       |
|---------------------------------|-----------------------|
| 1. Bolt                         | 12. Inlet tube        |
| 2. Lockwasher                   | 13. Hose clamp        |
| 3. Loader circuit pressure line | 14. Bolt              |
| 4. Preformed packing            | 15. Lockwasher        |
| 5. Bolt                         | 16. Tube flange       |
| 6. Lockwasher                   | 17. Low pressure hose |
| 7. Split flange                 | 18. Preformed packing |
| 8. Steering line                | 19. Preformed packing |
| 9. Preformed packing            | 20. Bolt              |
| 10. Bolt                        | 21. Lockwasher        |
| 11. Lockwasher                  | 22. Pump              |

Figure 8-11. Hydraulic pump, removal and installation.

*b. Disassembly.* Refer to figure 8-12.

(1) Draw a line down the length of the pump housing to ensure correct assembly.

(2) Remove four nuts (1) and washers (2) from the ends of the studs (3).

(3) Lift off the port end cover (4).

*Note.* If the pump sections must be pried apart, be careful not to damage machined surfaces.

(4) Remove the one-inch gear housing (5), drive gear (6), and driven gear (7) from the port end cover. Mark the gears for reassembly in their original positions.

(5) Unscrew and remove four studs (3).

(6) Remove the bearing carrier (8).

(7) Remove the two-inch gear housing (9), drive gear (10), and driven gear (11) from the shaft end cover. Mark the gears for reassembly in their original positions. Remove the shaft connector (12) from the two-inch drive gear.

(8) Disassemble the shaft end cover (13) as follows:

(a) Pry off the thrust plate (14) with a knife or thin screwdriver. Remove and discard pocket seals (15).

(b) Pull out the double lip seal (16) it is to be replaced.

(c) Pull the two roller bearings ( ) and remove the ring seal (18) if either is to be replaced.

(9) Disassemble the bearing carrier (8) as follows:

(a) Pry off the thrust plates (19 and 20) with a knife or thin screwdriver. Remove and discard the pocket seals (21 and 22).

(b) Pull the four bearings (23 and 24) with a bearing puller and remove the corresponding ring seal (25 and 26) if either bearing or ring seal is to be replaced.

(10) Disassemble the port end cover (4) as follows:

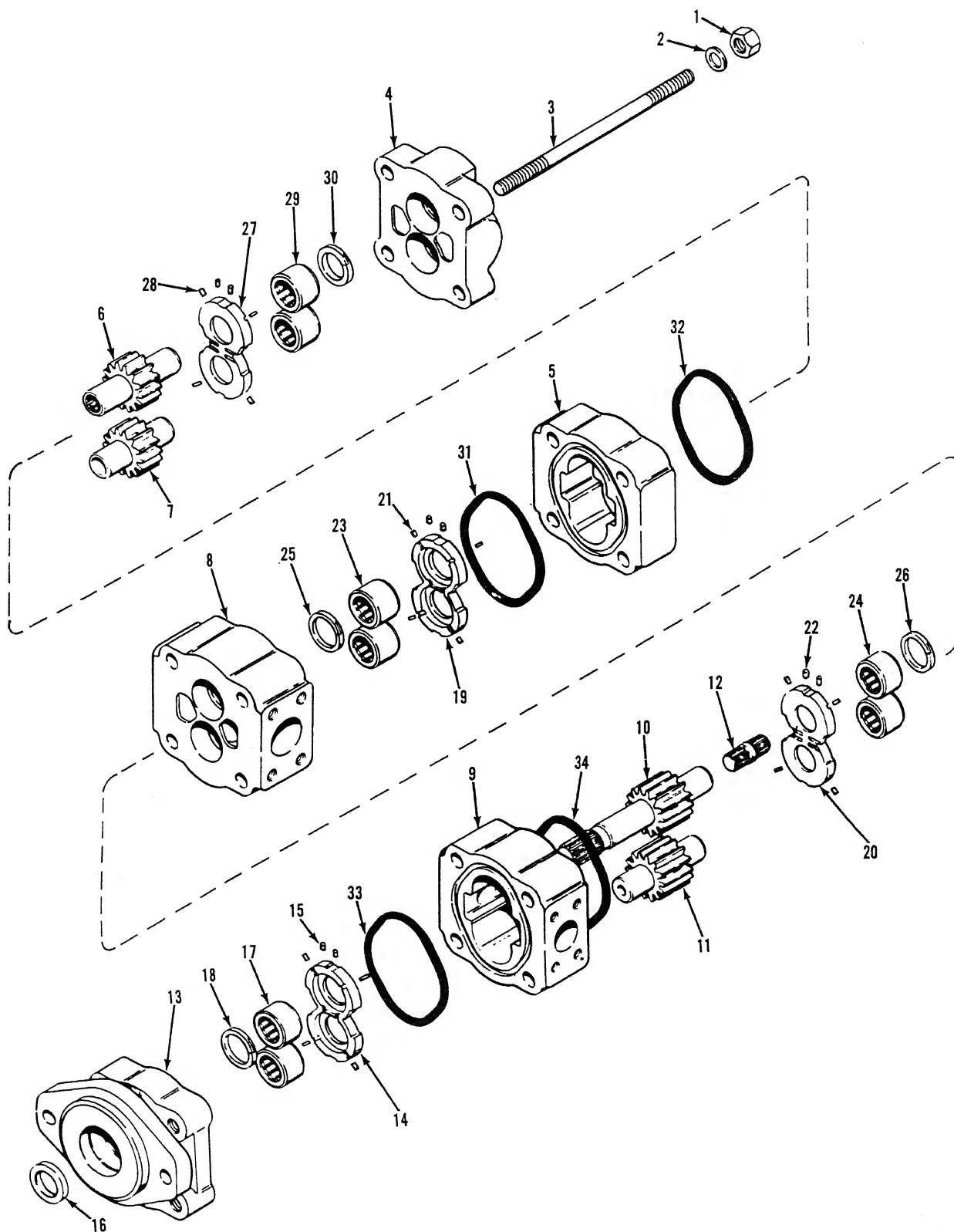
(a) Pry off the thrust plate (27) with a knife or thin screwdriver. Remove and discard the pocket seals (28).

(b) Pull the two roller bearings (29) with a bearing puller and remove the ring seal (30) if either is to be replaced.

(11) Remove and discard the preformed packings (31, 32, 33, and 34) in the groove on the one-inch and two-inch housing faces.

#### KEY to fig. 8-12:

1. Nut	18. Ring seal
2. Washer	19. Thrust plate
3. Stud	20. Thrust plate
4. Port end cover	21. Pocket seal
5. One-inch gear housing	22. Pocket seal
6. Drive gear	23. Roller bearings
7. Driven gear	24. Roller bearings
8. Bearing carrier	25. Ring seal
9. Two-inch gear housing	26. Ring seal
10. Drive gear	27. Thrust plate
11. Driven gear	28. Pocket seal
12. Shaft connector	29. Roller bearings
13. Shaft end cover	30. Ring seal
14. Thrust plate	31. Preformed packing
15. Pocket seal	32. Preformed packing
16. Double lip seal	33. Preformed packing
17. Roller bearings	34. Preformed packing



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Figure 8-12. Hydraulic pump, exploded view



*c. Cleaning, Inspection and Repair.*

(1) Inspect the gear housings as follows:

(a) Check gear housings for areas worn down by the gears and replace housings having wear in excess of 0.005 inch.

(b) Place a straight edge across the bore. If a 0.005 inch feeler gage can be slipped under the straight edge, replace the housing.

(c) Check for cutouts on the low pressure side where the gears are pushed against the housing. If excessive cutout occurs in a short period, check for high relief valve setting or contaminated oil.

(2) Inspect the gear teeth for scoring, grooving, burring, nicking, and fretting. Inspect the gear hubs for any wear detectable by touch or in excess of 0.002 inch. Replace gears in pairs only.

(3) Inspect the drive shaft as follows:

(a) Inspect the seal area for wear detectable by touch or in excess of 0.002 inch and replace as necessary. Excessive wear may indicate oil contamination.

(b) Check the shaft splines for damage and replace as necessary.

(c) Inspect the shaft connector and replace if damaged or worn.

(4) Inspect the thrust plates as follows:

(a) Replace the thrust plates if they are scored, eroded, or pitted or if they are worn beyond tolerances given in figure 8-13.

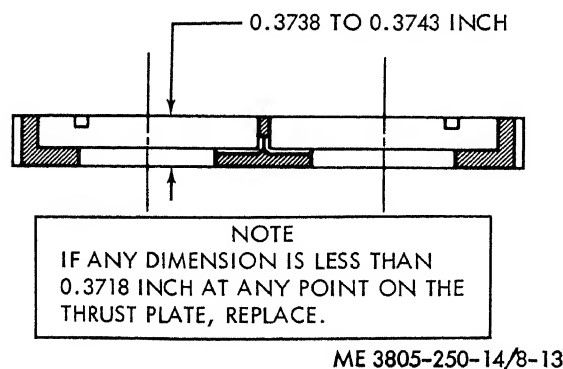


Figure 8-13. Thrust plate inspection.

(b) Check the center of the thrust plates where the gears mesh. If erosion is evident, replace and check for oil contamination.

(c) If thrust plates are pitted, replace plates and check pump for cavitation and oil aeration.

(d) If thrust plates are discolored, replace plates and check pump for overheating, possibly from insufficient oil.

(5) If gears are to be replaced, bearings may also be replaced. Bearings should fit into the bore with a light press fit, although a neat hand fit is permissible. If bearings can fall out, the bore may be oversized.

(6) Replace all rubber and polymer seals, including preformed packings, pocket seals, and shaft seals, when disassembling pump.

*d. Reassembly.* Refer to figure 8-12.

*Note.* Air-blast all parts and wipe dry with a lint-free cloth before assembly.

(1) Assemble shaft end cover (13) as follows:

(a) If the double lip seal (16) was removed, coat outside of the new seal and its recess with thread sealing compound. With the metal side facing the shaft, press the seal into the shaft end cover. Wipe excess sealant and ensure that the seal is firmly seated in its recess.

(b) If the two roller bearings (17) were removed, install a new ring seal (26) behind the bearing for the two-inch drive gear (10) so that the slot faces the bearings. Press new bearings into the shaft end cover as far as they will go.

(c) Guide the shaft into the cover using care not to cut the double lip seal (16).

(d) Place a small amount of heavy grease into the two middle slots in the open face of the thrust plate (14) and insert pocket seals (22).

(e) Place the thrust plate over the bearings with the pocket seals slots toward the face of the shaft end cover. Check to see that the pocket seals in the center slots are still in place. Tap the thrust plate into position until a clearance of approximately  $1/32$  inch is left between the thrust plate and the shaft end cover.

(f) Insert a pocket seal into each of the open slots in the thrust plate. Be sure to push the seal all the way into the slot so that the hidden lip contacts the roller bearing race. Tap the assembly into position against the face of the shaft end cover. Trim away the excess from the exposed ends of the pocket seals with a razor blade or sharp knife. Trim square and flush with the surface of the thrust plate.

(2) Assemble the port end cover (4) as follows:

(a) If the roller bearings (29) were removed, install a new ring seal (30) in the bore for the two-inch drive gear so that the slot faces the gear. Press new bearings into the port end cover as far as they will go.

(b) Assemble and install thrust plate (27) as described in step (1).

(3) Assemble the bearing carrier (8) as follows:

(a) If the roller bearings (23 and 14) were removed, install a new corresponding ring seal (25 or 18) in the drive gear bore so that the slot faces the gears. Press new bearings into the bores of the bearing carrier as far as they will go.

(b) Assemble and install thrust plates (19 and 14) as described in step (1).

(4) Place the assembled shaft end cover (13) in a vise, gear side up.

(5) Pour a small amount of oil on the face of the thrust plate (20) to lubricate the gears. Stone the gear ends to remove any burrs. Install the two-inch drive gear (10) on the shaft and the driven gear (11) in its bore. If old gears are being reinstalled, align the marks made on the gears during assembly. Squirt oil on the gears for initial lubrication when the pump is started. Insert the shaft connector (12) into the two-inch drive gear.

(6) Stone the face of the two-inch gear housing (9) to remove any burrs. Blow or carefully wipe clean. Install greased preformed packings (33 and 34) in the grooves in the housing faces.

(7) Place the two-inch gear housing over the gears and tap into position with a soft hammer.

(8) Install the bearing carrier (8) on the two-inch gear housing. Tap the bearing carrier in place with a soft hammer, using care not to pinch the O-ring in the two-inch gear housing.

(9) Install the one-inch drive gear (6) over the shaft connector and place the driven gear (7) into its bore. If the old gears are being reinstalled, align the marks made on the gears during disassembly. Squirt oil on the gears to provide initial lubrication when the pump is started.

(10) Install greased preformed packings (31 and 32) in the grooves in the face of the one-inch gear housing.

*Note.* The one-inch gear housing may be rotated 180 degrees from the previous installation to present a new surface to the pressure.

(11) Place the one-inch gear housing over the gears and tap into place against the bearing carrier. Take care not to pinch the preformed packing in the face of the one-inch gear housing.

(12) Install the port end cover (4) on the one-inch gear housing using a soft hammer to tap the port end cover against the gear housing. Take care not to pinch the preformed packing on the face of the one-inch gear housing.

(13) Thread the four studs (3) into the shaft end cover, leaving enough thread protruding above the port end cover for the washers (2) and nuts (1).

(14) Install washers and nuts and tighten evenly to a torque of 200 pound-feet. Rotate the

drive shaft with a six-inch wrench while tightening the nuts.

(15) Turn the drive shaft with the wrench to make sure the shaft turns freely and does not bind.

*e. Installation.* Refer to figure 8-11.

(1) Carefully guide the pump drive shaft into engagement with the splines of the pump coupling. With the splines engaged, mount the pump into position with two bolts (20) and lockwashers (21).

(2) Place a new preformed packing (4) on the pressure line (3) fittings. Secure the line to the pump with four bolts (1) and lockwashers (2).

(3) Position the split flange (7) on steering line (8) and new preformed packing (9), and secure with four bolts (5) and lockwashers (6).

(4) Install flange (16) and new preformed packing (19) with bolts (14) and lockwashers (15). Slip low pressure hose (17) and clamps (13) over the flange.

(5) Secure the inlet tube (12) in position with four bolts (10) and lockwashers (11).

(6) Tighten all fittings as specified in paragraph 1-7.

(7) Service the hydraulic reservoir with approximately 20.8 gallons of hydraulic fluid.

(8) Pressurize the air system.

(9) Run the engine at half speed with the pump at zero pressure (all control levers in neutral) for three minutes.

(10) Increase engine speed to full throttle and operate the control levers intermittently for three minutes.

(11) Idle the engine and check the pump and hydraulic connections for leaks. Check the hydraulic oil level and replenish as necessary.

## 8-9. Hydraulic Oil Tank

### *a. Removal.*

(1) Remove the front end access panel.

(2) Close the air valve on the tank and slowly loosen the filler cap to depressurize the tank. Remove the two drain plugs and drain the tank.

(3) Disconnect the steering gear line (1, fig. 8-14) from the tank. Remove elbow and preformed packing.

(4) Disconnect the steering relief valve line (2) and remove connecting elbow and preformed packing.

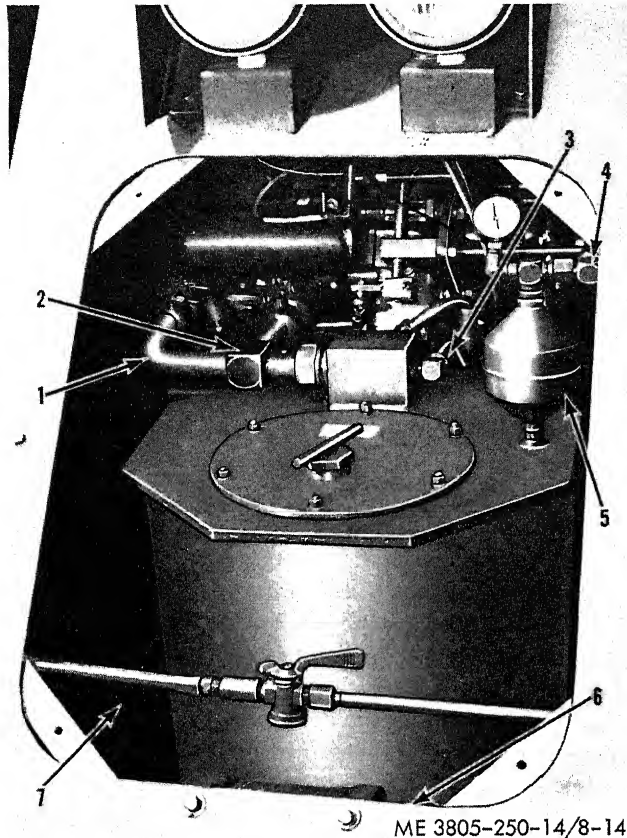
(5) Disconnect the loader control valve line (3) and remove O-ring.

(6) Disconnect the air line (4) to the breather assembly (5).

(7) Remove three bolts, nuts, and lockwashers securing the bottom of the tank to the frame.

(8) Remove four bolts and lockwashers securing the split flange (6) to the clamp mounting studs. Remove outlet line (7) from the bottom of the tank.

(9) Lift the tank and carefully guide it out through the front opening.



1. Steering gear line
2. Steering relief valve line
3. Loader control valve line
4. Air line
5. Breather assembly
6. Split flange
7. Outlet line

Figure 8-14. Hydraulic oil tank, removal and installation.

*b. Disassembly.* Disassemble the hydraulic tank as instructed in paragraph 3-11.

*c. Cleaning, Inspection and Repair.*

(1) Clean filter relief valves. Wash thoroughly with hydraulic fluid.

(2) Clean the interior of the tank with hydraulic fluid and a clean, lint-free cloth.

(3) Replace all gaskets, preformed packing elements.

*d. Reassembly.* Assemble the hydraulic tank as instructed in paragraph 3-11.

*e. Installation.* Refer to figure 8-14.

*Note.* Ensure that tank and mounting area are clean.

(1) Carefully position the tank on its mounting.

(2) Connect the outlet line (7) to the bottom of the tank with split flange (6) and four bolts and lockwashers.

(3) Secure the tank to the frame with three bolts, nuts, and lockwashers.

(4) Connect the air line (4) to the breather assembly (5).

(5) Connect the loader control valve (3) and new preformed packing to tank opening.

(6) Connect the steering relief valve line (2) to the tank opening with elbow and a new preformed packing.

(7) Connect the steering gear line (1) to the tank opening with a clamp, elbow, and new preformed packing.

(8) Install the drain plugs and fill tank with 20.8 gallons of hydraulic fluid. Open the air valve and start the engine.

(9) Check the tank and tank connections for leaks.

(10) Install the front end access panel.

### 8-10. Hose Repair.

Hose repair is limited to replacing connectors between hoses. In emergency situations, cracked hoses may be repaired by splicing. However, it is recommended that hoses be replaced whenever possible.

## Section III. HYDRAULIC LIFT COMPONENTS

### 8-11. General

*a.* The hydraulic lift system utilizes hydraulic fluid to control the operation of the lift arms and loader bucket. The system consists of a three-spool loader control valve, right and left lift, tilt, and clam cylinders, and control lines and linkages.

*b.* Hydraulic fluid from the oil reservoir is

pumped to the three-spool control valve. The controls operate the valve and distribute hydraulic fluid to the lift, tilt, and clam cylinders. The valve operates the cylinders, raising and lowering the arms, tilting the bucket, and operating the clam.

*c.* Refer to figure 1-4 for a schematic diagram of the hydraulic system.

## 8-12. Loader Control Valve

### a. Removal.

*Note.* Remove the control valve with the bucket lowered to the ground.

(1) Close the air valve on the hydraulic reservoir and slowly loosen the reservoir filler cap to depressurize the reservoir. Remove the drain plugs and drain the reservoir.

(2) Work the control levers back and forth to relieve oil pressure in the lines and control valve.

(3) Ensure that the control valve and surrounding areas are clean.

(4) Loosen two screws and remove the clamp securing the fuel shutoff cable (fig. 8-15). Disconnect electrical wiring to the lift and tilt microswitches and to the solenoids on the bottom of the valve.

(5) Remove three nuts, lockwashers, bolts, washers, and spacers securing the microswitch mounting plate to the valve, and remove the mounting plate.

(6) Disconnect the outlet line on the port side of the valve at the elbow and remove elbow, preformed packing, and restrictor fitting.

*Note.* Cap or plug lines and fittings as soon as they are disconnected.

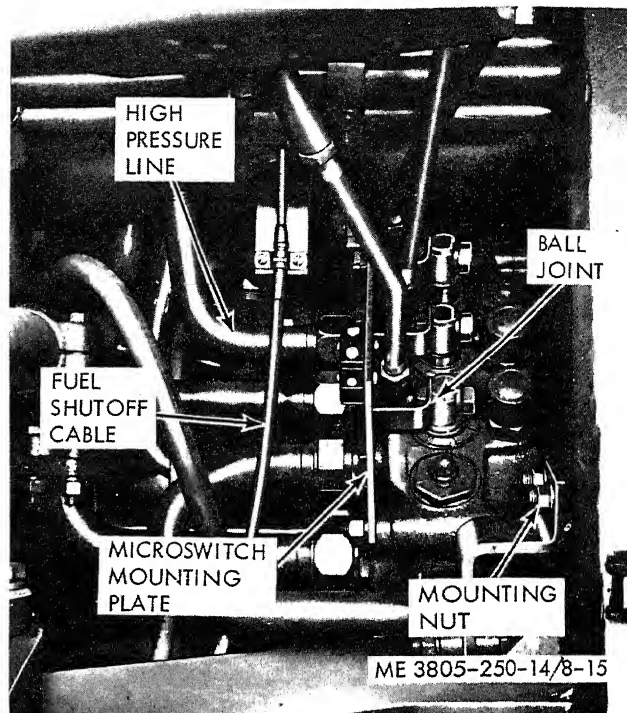
(7) Disconnect the outlet line from the end of the valve.

(8) Disconnect the inlet line.

(9) Disconnect the male connectors and preformed packings securing the high pressure lines to the valve.

(10) Remove the nuts and lockwashers securing the clam, lift, and tilt spools to their corresponding ball joints. Remove the microswitch actuating tabs from the lift and tilt ball joints.

(11) Support the valve and remove the remaining mounting nut and lockwasher. Remove the valve from the loader.



*Figure 8-15. Loader control valve, removal and installation.*

### b. Disassembly. Refer to figure 8-16.

(1) Remove and disassemble the clam spool (1) as follows:

(a) Unscrew spool cap (2) from the valve body and grasp the spool at the spring end and pull from valve body.

(b) Clamp the spool in a soft-jawed vise and tighten vise to compress the spring.

(c) Remove snap ring (3), and remove the spool from the vise.

(d) Remove outer spring retainer (4), spring (5), travel limit washer (6), and inner spring

retainer (7) from spool. Remove retainer (8) and preformed packing (9).

(e) Fabricate the special tool shown in figure 5-13 and remove the plastic wiper (10). Then remove retainer (11) and preformed packing (12).

(2) Remove and disassemble tilt spool (13) as follows:

(a) Grasp the detent housing (14) and unscrew from valve body. Pull the spool assembly from the valve.

(b) Remove snap ring (15), preformed packing (16), plunger stop (17), and solenoid coil (18) from solenoid housing (19).

(c) Loosen setscrew (20) in solenoid housing and separate solenoid housing from detent housing. Remove and discard preformed packing (21).

(d) Remove spring retainer (22) from the solenoid housing. Remove spring (23), plunger (24), ball retainer (25), and six balls (26) from sleeve (27). Do not remove the sleeve from detent housing.

(e) Remove wiper (28), preformed packing (29), spool gland (30), and preformed packing (31) from the valve housing.

(f) Clamp the spool in a soft-jawed vise and remove eye (32) from the spool. Remove from vise.

(g) Remove poppet seat (33), preformed packing (34), poppet (35), backup ring (36), preformed packing (37), and spring (38) from spool. Remove preformed packing (39) and retainer (40).

(h) Remove the pins (41) and separate the spool (13) from the detent housing. Remove the detent barrel (42), link (43) and centering spring (44).

(3) Remove and disassemble lift spool (45) as follows:

(a) Grasp the detent housing (46) and unscrew from valve body. Pull the spool assembly from the valve.

(b) Remove snap ring (47), preformed packing (48), plunger stop (49), and solenoid coil (50) from solenoid housing (51).

(c) Loosen setscrew (52) and unscrew the solenoid housing from detent housing (46). Remove preformed packing (53).

(d) Remove spring retainer (54) from solenoid housing. Remove spring (55), solenoid plunger (56), ball retainer (57), and six balls (58) from sleeve (59). Do not remove the sleeve from detent housing.

(e) Remove the pins (60) and separate the spool (45) from the detent housing (46). Remove

the detent barrel (61), link (62) and centering spring (63).

(f) Remove the wiper (64), preformed packing (65), and retainer (66). Remove preformed packing (67) and sleeve (68) from valve housing.

(g) Remove retainer (69), preformed packings (70 and 71), and retainer (72).

(4) Remove and disassemble the main relief valve as follows:

(a) Remove the acorn nut (73), washer ( ), locknut (75), washer (76) and the relief valve adjusting screw (77).

(b) Unscrew the relief valve cap (78) and remove from valve body. Remove plunger seat ( ) if it is to be replaced. Remove the plunger (80) and spring (81) from cap.

(c) Remove spring (82) and poppet ( ) from valve bore. Remove preformed packings ( ) and backup ring (85).

(d) Remove valve plug (86) and preformed packing (87) at the opposite end of the bore. Remove drain sleeve (88) from valve bore, and remove the poppet seat (89) from the sleeve if it is to be replaced.

(e) Remove backup ring (90) and preformed packing (91) from poppet.

(5) Remove and disassemble the second relief valves, located opposite both ends of the spool and at the top of the lift and clam spools as follows:

*Note.* Mark valve components for reinstallation in bores from which they are removed.

(a) Unscrew relief valve cap (92) and remove the cap from valve body. Remove the preformed packings (93) and three backup rings (94) from cap.

(b) Remove spring (95) and poppet ( ) from valve bore.

*Note.* Do not remove poppet seat (97) unless it is to be replaced.

(6) Disassemble check valves, located opposite the bottom of the lift and clam spools, as follows:

*Note.* Mark valve components for reinstallation in bores from which they are removed.

(a) Unscrew cap (98) and remove the cap from valve body. Remove three preformed packings (99) and three backup rings (100) from the cap.

(b) Remove spring (101) and poppet ( ) from valve bore.

*Note.* Do not remove poppet seat (103) unless it is to be replaced.

(7) Remove and disassemble regeneration and check valve, opposite top of lift spool, as follows:

(a) Unscrew valve cap (104) and remove from valve body. Remove three preformed packings (105) and three backup rings (106) from the cap.

(b) Clamp the valve cap in a vise and remove plug (107) from the cap. Remove poppet (108) from valve cap and remove preformed packing (109) from the plug. Remove from vise.

(c) Remove spring (110) and poppet (111) from valve bore.

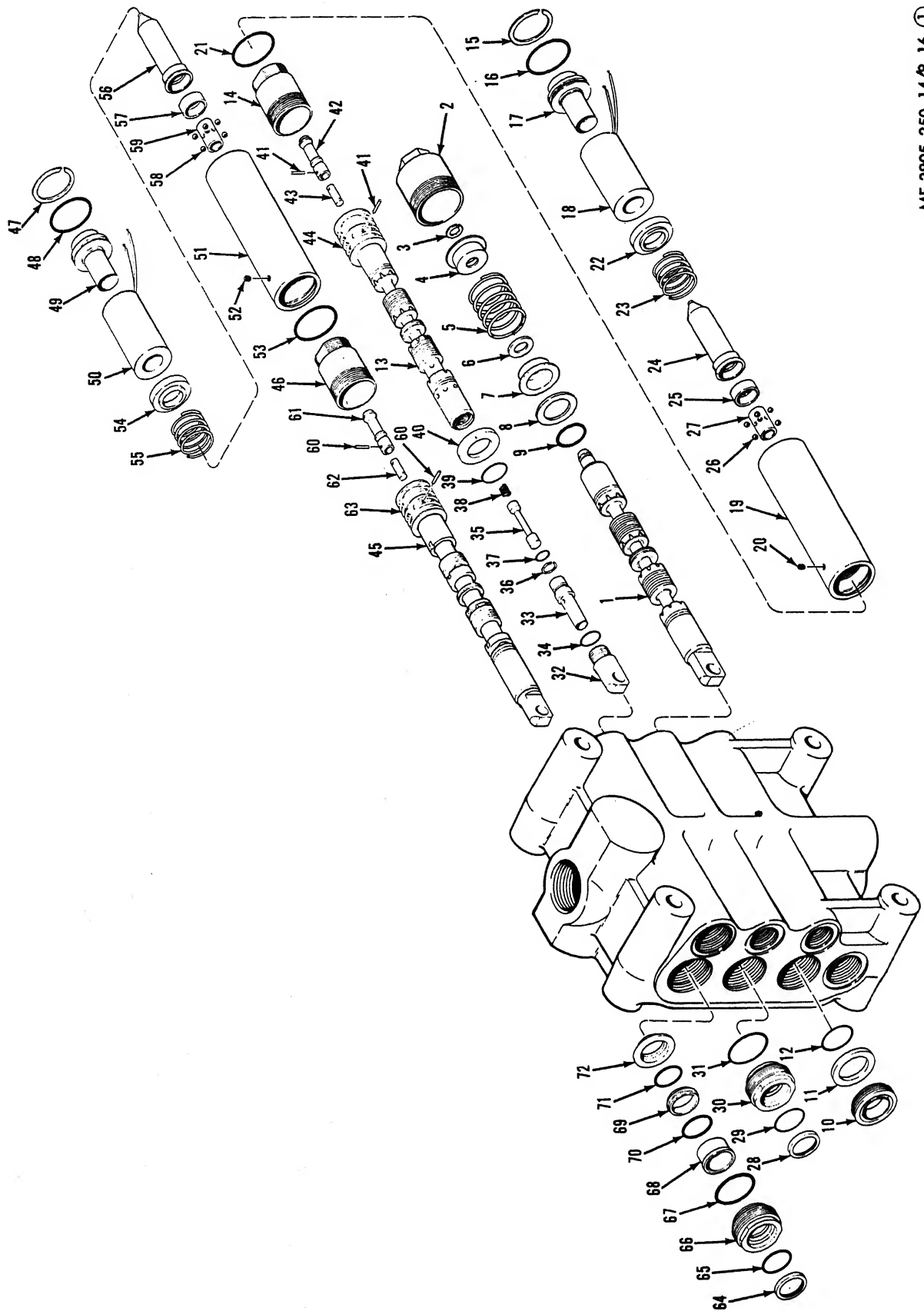
*Note.* Do not remove poppet seat (112) unless it is to be replaced.

(8) Remove high pressure carry-over fitting (113) and two preformed packings (114 and 115) from the valve.

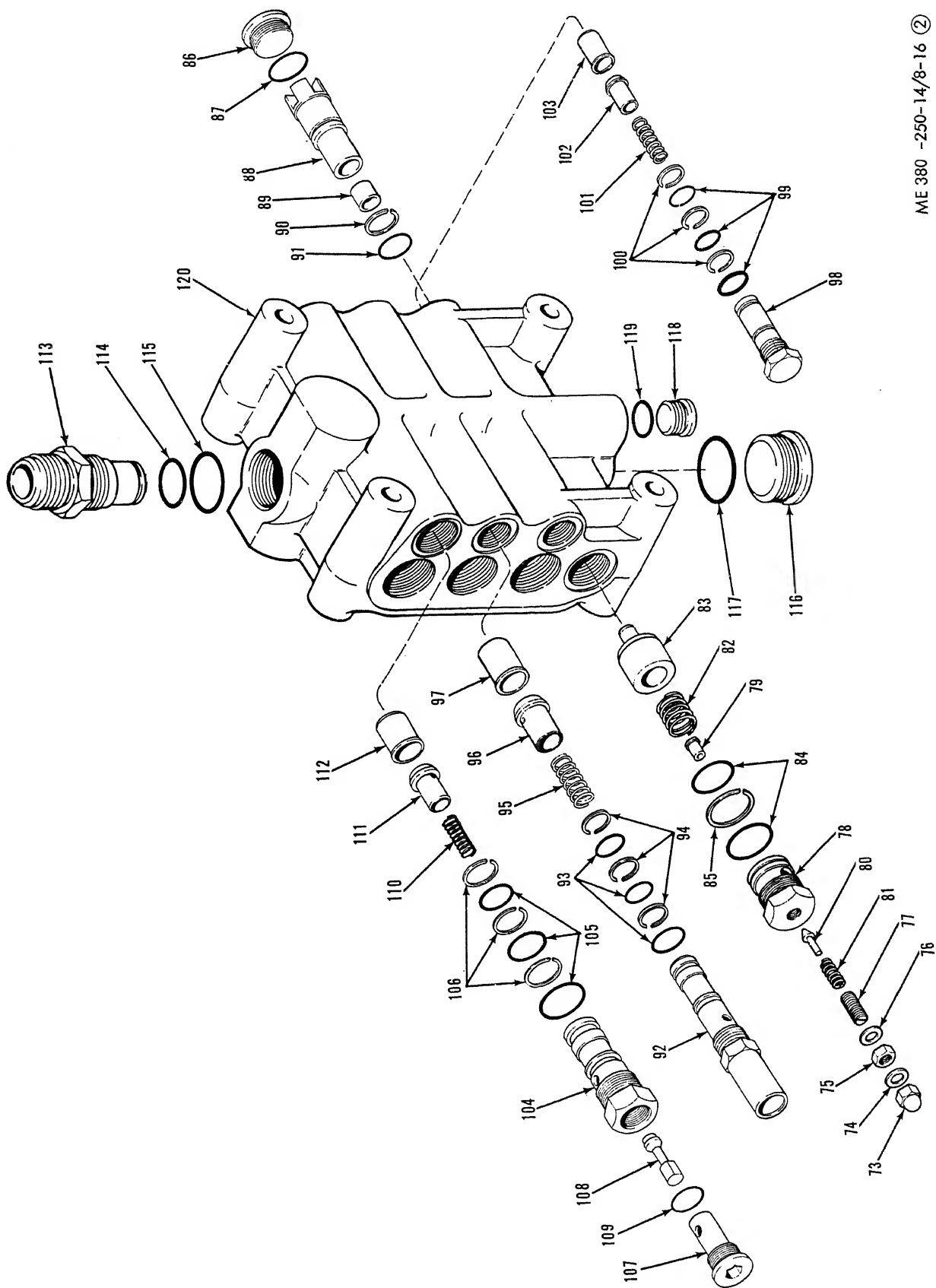
(9) Remove plug (116), preformed packing (117), plug (118) and preformed packing (119) from valve body.

**KEY to fig. 8-16:**

- |                        |                                       |
|------------------------|---------------------------------------|
| 1. Clam spool          | 61. Detent barrel                     |
| 2. Spool cap           | 62. Link                              |
| 3. Snap ring           | 63. Centering spring                  |
| 4. Spring retainer     | 64. Wiper                             |
| 5. Spring              | 65. Preformed packing                 |
| 6. Travel limit washer | 66. Retainer                          |
| 7. Spring retainer     | 67. Preformed packing                 |
| 8. Retainer            | 68. Sleeve                            |
| 9. Preformed packing   | 69. Retainer                          |
| 10. Wiper              | 70. Preformed packing                 |
| 11. Retainer           | 71. Preformed packing                 |
| 12. Preformed packing  | 72. Retainer                          |
| 13. Tilt spool         | 73. Acorn nut                         |
| 14. Detent housing     | 74. Washer                            |
| 15. Snap ring          | 75. Locknut                           |
| 16. Preformed packing  | 76. Washer                            |
| 17. Plunger stop       | 77. Adjusting screw                   |
| 18. Solenoid coil      | 78. Cap                               |
| 19. Solenoid housing   | 79. Plunger seat                      |
| 20. Setscrew           | 80. Plunger                           |
| 21. Preformed packing  | 81. Spring                            |
| 22. Spring retainer    | 82. Spring                            |
| 23. Spring             | 83. Poppet                            |
| 24. Plunger            | 84. Preformed packing                 |
| 25. Ball retainer      | 85. Backup ring                       |
| 26. Ball               | 86. Plug                              |
| 27. Sleeve             | 87. Preformed packing                 |
| 28. Wiper              | 88. Drain sleeve                      |
| 29. Preformed packing  | 89. Poppet seat                       |
| 30. Spool gland        | 90. Backup ring                       |
| 31. Preformed packing  | 91. Preformed packing                 |
| 32. Eye                | 92. Cap                               |
| 33. Poppet seat        | 93. Preformed packing                 |
| 34. Preformed packing  | 94. Backup ring                       |
| 35. Poppet             | 95. Spring                            |
| 36. Backup ring        | 96. Poppet                            |
| 37. Preformed packing  | 97. Poppet seat                       |
| 38. Spring             | 98. Cap                               |
| 39. Preformed packing  | 99. Preformed packing                 |
| 40. Retainer           | 100. Backup ring                      |
| 41. Pin                | 101. Spring                           |
| 42. Detent barrel      | 102. Poppet                           |
| 43. Link               | 103. Poppet seat                      |
| 44. Centering spring   | 104. Cap                              |
| 45. Lift spool         | 105. Preformed packing                |
| 46. Detent housing     | 106. Backup ring                      |
| 47. Snap ring          | 107. Plug                             |
| 48. Preformed packing  | 108. Poppet                           |
| 49. Plunger stop       | 109. Preformed packing                |
| 50. Solenoid coil      | 110. Spring                           |
| 51. Solenoid housing   | 111. Poppet                           |
| 52. Setscrew           | 112. Poppet seat                      |
| 53. Preformed packing  | 113. High pressure carry-over fitting |
| 54. Spring retainer    | 114. Preformed packing                |
| 55. Spring             | 115. Preformed packing                |
| 56. Solenoid plunger   | 116. Plug                             |
| 57. Ball retainer      | 117. Preformed packing                |
| 58. Ball               | 118. Plug                             |
| 59. Sleeve             | 119. Preformed packing                |
| 60. Pin                | 120. Housing                          |







ME 380 -250-14/8-16 ②

Figure 8-16. Loader control valve, exploded view (Sheet 2 of 2).



*c. Cleaning, Inspection and Repair.*

(1) Wash all parts in solvent.

(2) Inspect the valve body bores and spools for grooves, deep scratches, or excessive wear. The spools should fit their respective body bores with a slight hand pressure and without perceptible side clearance. Valve spools may be replaced if valve body shows no damage.

(3) Inspect check valve, secondary relief valve, and regeneration valve poppets and their respective seats for grooves or other defects which may cause leakage. Also check the poppet for bore fit.

(4) Inspect relief valve plunger and seat for ridges or scoring.

(5) Discard all preformed packings and replace with new ones.

*d. Reassembly.* Refer to figure 8-16.

*Note.* Before reassembling the valve, ensure that the bench, tools, and all valve components are clean and free from dust and foreign matter. Coat all parts and body bores with hydraulic fluid.

(1) Install high pressure carry-over fitting (113) with two preformed packings (114 and 115).

(2) Install plug (116) and preformed packing (117), and install plug (118) and preformed packing (119).

(3) Assemble regeneration and check valve as follows:

(a) Install new poppet seat (112) into valve body if seat was removed.

(b) Clamp valve cap (104) in a vise and place poppet (108) in the cap. Install plug (107) with preformed packing (109) in the cap and tighten securely. Remove from vise.

(c) Install backup rings (106) and preformed packings (105) in valve cap.

(d) Place spring (110) in poppet (111) and position the poppet assembly in valve cap.

(e) Install assembled valve cap in the valve body and tighten securely.

(4) Assemble check valves as follows:

*Note.* Install valve parts that are being reused in the same bores from which they were removed.

(a) Press new poppet seat (103) into the valve body if seat was removed.

(b) Install backup rings (100) and preformed packing (99) on the valve cap (98), and position spring (101) and poppet (102) in cap.

(c) Place assembled valve cap in the valve body and tighten securely.

(5) Assemble secondary relief valves as follows:

*Note.* Install valve parts that are being reused in the same bores from which they were removed.

(a) Press a new poppet seat (97) into the valve body if the seat was removed.

(b) Install backup rings (94) and preformed packings (93) on valve cap (92), and position spring (95) and poppet (96) in cap.

(c) Place assembled valve cap in the valve body and tighten securely.

(6) Assemble and install main relief valve as follows:

(a) Install poppet seat (89) in drain sleeve (88). Position backup ring (90) and preformed packing (91) on sleeve, and install the sleeve on valve body.

(b) Place preformed packing (87) on plug (86), and screw the plug into the valve body.

(c) Place poppet (83) on valve body and position large spring (82) in poppet.

(d) Install adjusting screw (77) in valve cap. Do not tighten adjusting screw. Then position spring (81), plunger (80), and plunger seat (79) in cap.

(e) Install preformed packing (84) and backup ring (85) on cap. Screw cap assembly into valve body.

(f) Install washer (76) and install and tighten locknut (75). Install washer (74) and acorn nut (73) on the adjusting screw.

*Note.* Do not attempt to adjust the relief valve until the control valve is installed in the loader. Refer to subparagraph *f* for relief valve check and adjustment.

(7) Assemble and install lift spool (45) as follows:

(a) Assemble centering spring (63) on the lift spool (45). Position the link (62) and detent barrel (61) in the detent housing (46). Install the detent housing to the spool and secure with two pins (60).

(b) Install new wiper (69) and preformed packing (65) in spool retainer (66). Install spool sleeve (68) on opposite end of retainer.

(c) Screw retainer and preformed packing (67) into valve body and tighten securely.

(d) Place retainer (72) preformed packing (71), retainer (69) and preformed packing (70) on spool and position the spool in valve body.

(e) Screw detent housing (46) into valve body.

(f) Spread grease over the holes in sleeve (59) and place six balls (58) in sleeve. Position ball retainer (57) on sleeve.

(g) Position solenoid plunger (56) over ball retainer and place spring (55) on plunger.

(h) Position new preformed packing (53) and spring retainer (54) in solenoid housing (51).

Screw solenoid housing into detent housing approximately  $\frac{1}{8}$  inch.

(i) Install preformed packing (48) on plunger stop (49), and position stop in solenoid housing. Secure stop in housing with snap ring (47).

(j) Screw solenoid housing down until the plunger bottoms against the plunger stop. Back off solenoid housing two turns and tighten setscrew (52).

(7) Assemble and install tilt spool (13) as follows:

(a) Assemble the centering spring (44) on the tilt spool (13). Position the link (43) and detent barrel (42) in the detent housing (14). Install the detent housing to the spool and secure with two pins (41).

(b) Install backup ring (36) and preformed packing (37) on poppet seat (33).

(c) Position spring (38) in the recess on the end of poppet (35) and place the poppet in the seat.

(d) Clamp the spool in a soft-jawed vise and install preformed packing (34) and spool eye (32). Tighten eye securely and remove from vise.

(e) Install new wiper (28) and preformed packing (29) in spool gland (30). Install preformed packing (31) on the opposite end of the gland, and install the gland in the valve body.

(f) Position retainer (40) and preformed packing (39) on the spring end of the spool, and position the spool in the valve body. Be careful not to damage preformed packings when installing spool.

(g) Screw detent housing (14) into valve body.

(h) Spread grease over the holes in sleeve (27) and place six balls (26) in the sleeve. Position ball retainer (25) on sleeve.

(i) Position solenoid plunger (24) over ball retainer and place spring (23) on plunger.

(j) Position preformed packing (21) and spring retainer (22) in solenoid housing (19). Screw solenoid housing into detent housing (14) approximately  $\frac{1}{8}$  inch.

(k) Install preformed packing (16) on plunger stop (17), and position the stop in solenoid housing. Secure the stop with snap ring (15).

(l) Screw solenoid housing down until the plunger bottoms against the plunger stop. Back off solenoid housing two turns and tighten setscrew (20).

(8) Assemble and install clam spool (1) as follows:

(a) Install preformed packing (12), retainer (11), and plastic wiper (10) in top of valve body.

(b) Clamp the valve spool in a soft-jawed

vise and position preformed packing (9) and retainer (8) on the spool. Place the inner spring retainer (7), travel limit washer (6), spring (5) and outer spring retainer (4) on the spool. Compress the spring and install snap ring (3). Ensure that the snap ring is seated in the groove on the valve spool. Remove from vise.

(c) Position the spool in the valve body. Use care not to damage the preformed packing.

(d) Screw spool cap (2) into valve body.

#### e. Installation.

(1) Install valve by reversing the removal procedure.

(2) Ensure that the drain plugs are installed on the hydraulic reservoir, and fill with hydraulic fluid.

(3) Check and adjust the main relief valve (subpara f).

(4) Operate the system until the relief valve opens, and check the valve and hydraulic lines for leaks.

#### f. Main Relief Valve Check and Adjustment.

*Note.* Check and adjust relief valve with loader bucket resting on the ground.

(1) With the air valve on the hydraulic reservoir closed, slowly loosen the filler cap to depressurize the reservoir. Lock chassis sections with the safety bar.

(2) Operate bucket control levers to relieve system pressure.

(3) Remove the plug from the pressure check port on the left side of the tilt manifold and install a 0 to 3000 psi pressure gage (fig. 8-17).

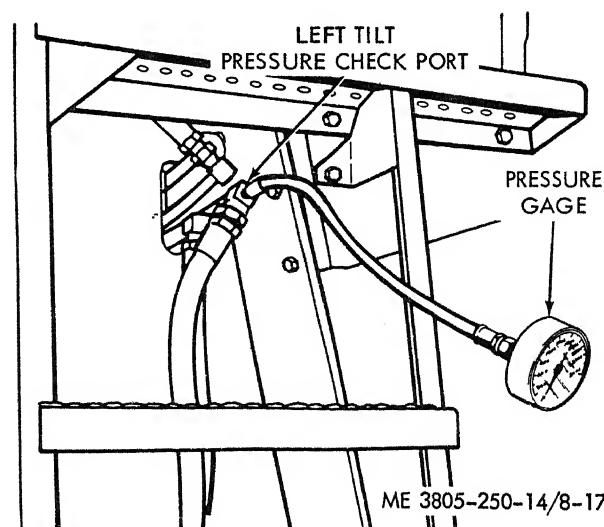


Figure 8-17. Pressure gage installation.

(4) Tighten the filler cap and open the air valve on the reservoir. Start engine and run at half throttle.

(5) Raise the bucket enough to permit full dump. Slowly push the tilt lever forward until the bucket is in full dump position and hold so that hydraulic pressure forces the relief valve open.

(6) Gradually increase engine speed to high idle.

(7) Note the pressure gage reading. The gage should register 2250 to 3300 psi at high idle.

(8) If the gage does not register the required reading, adjust the relief valve as follows:

(a) Remove the acorn nut (fig. 8-18) from the relief valve adjusting screw and loosen locknut.

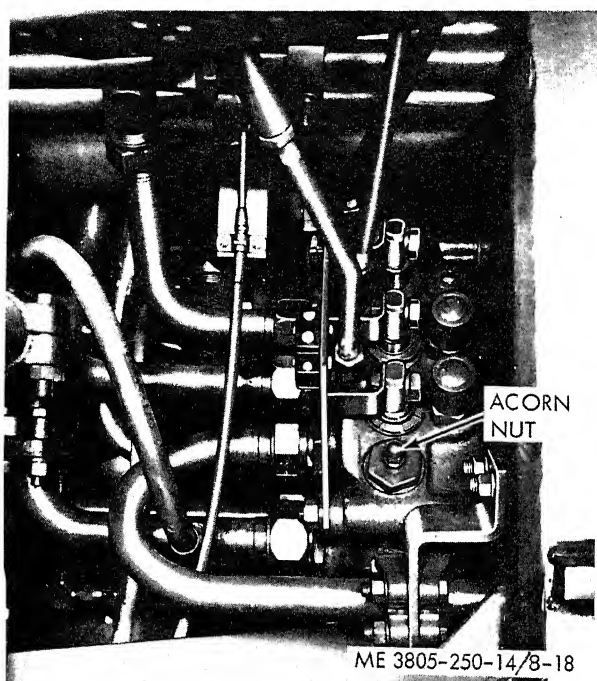


Figure 8-18. Relief valve adjustment.

(b) With the engine running at high idle and the tilt control lever all the way forward, turn the adjusting screw in or out until the gage registers 2250 to 2300 psi. Tighten the locknut and install the acorn nut.

(9) Depressurize the hydraulic system as described in step (1).

(10) Remove the pressure gage and reinstall plug.

(11) Check the level of hydraulic fluid and add as necessary. Open the air valve on the reservoir.

### 8-13. Hydraulic Cylinders

a. *Lift Cylinder Removal.* Refer to figure 8-19.

(1) Lower the bucket to the ground. Wash the

exterior of the cylinder and its fittings to remove mud, dirt, and grease.

(2) Move the lift control lever back and forth to relieve pressure in the circuit.

(3) Disconnect the line to the cylinder rod end. Discard preformed packing.

*Note.* Cap or plug ports and openings as soon as they are disconnected.

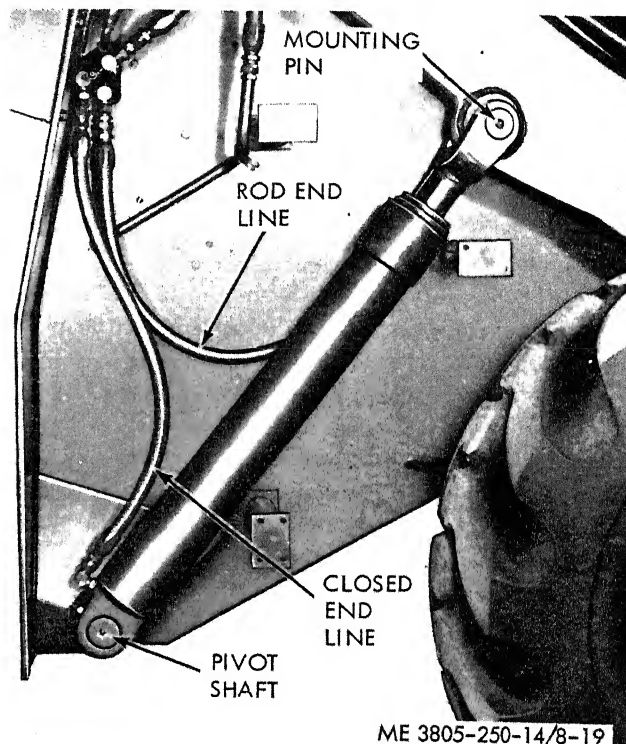


Figure 8-19. Lift cylinder, removal and installation.

(4) Disconnect the line to the cylinder closed end. Discard preformed packing.

(5) Support the cylinder so that it does not fall when the mounting pins are removed. The cylinder weighs approximately 200 pounds.

(6) Remove the nut and bolt securing the cylinder mounting pin in position at the rod end and remove the pin.

(7) Remove the nut and bolt from each end of the lift cylinder pivot shaft, and drive the shaft far enough to allow removal of the cylinder.

(8) Place the cylinder on a clean work bench and drain hydraulic fluid.

b. *Tilt Cylinder Removal.* Refer to figure 8-20.

*Note.* Remove the cylinder with the bucket resting on the ground.

(1) Wash the exterior of the cylinder and its fittings to remove mud, dirt, and grease.

(2) Move the tilt control lever back and forth to relieve pressure in the circuit.

(3) Disconnect the line (1) to the rod end of the cylinder. Discard preformed packing.

*Note.* Cap or plug ports and openings as soon as they are disconnected.

(4) Disconnect the line (2) at the closed end of the cylinder. Discard the preformed packing.

(5) Disconnect the two bolts, nuts and lock-washers securing the tube clamp (3) into position and remove the clamp.

(6) On the right tilt cylinder, remove the return

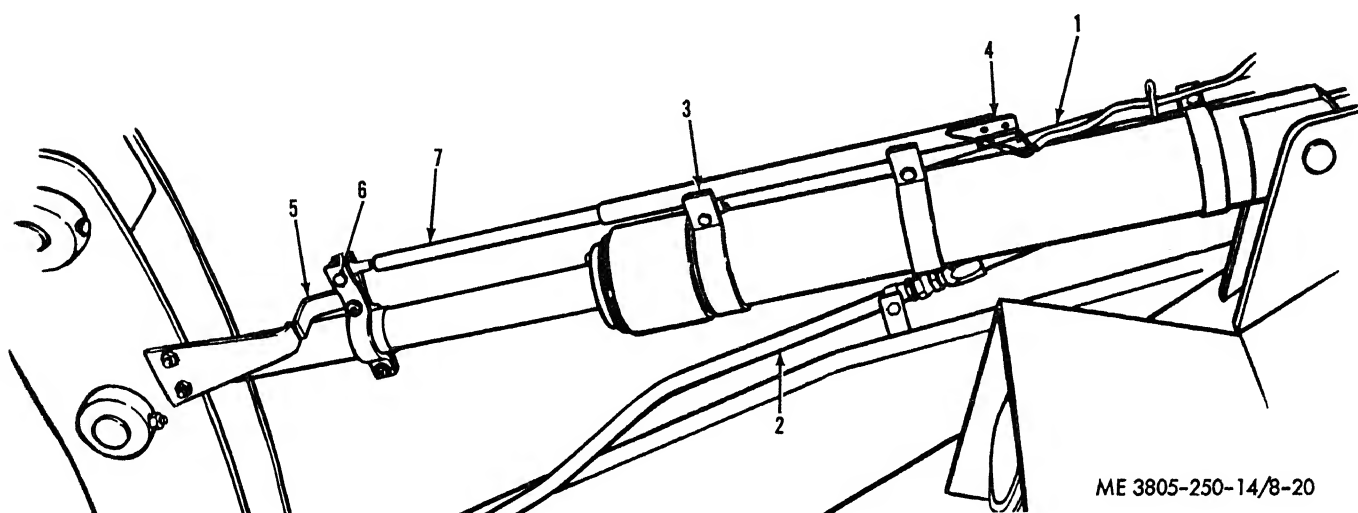
to dig controls (items 4 through 7) as instructed in paragraph 4-60.

(7) Support the cylinder and remove the bolt and nut (8) from the rod end.

*Note.* The cylinder weighs approximately 170 pounds.

(8) Remove the retaining ring and washers from both ends of the tilt cylinder pivot shaft (9). Drive in the shaft far enough to permit removal of the cylinder.

(9) Place the tilt cylinder on a clean work bench and drain the hydraulic fluid.



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1. Line
2. Line
3. Tube clamp
4. Microswitch
5. Mounting bracket
6. Pivot bolt
7. Control rod
8. Bolt and nut
9. Pivot shaft

*Figure 8-20. Tilt cylinder, removal and installation.*

*c. Clam Cylinder Removal.* Refer to figure 8-21.

*Note.* Remove the cylinder with the bucket resting on the ground.

(1) Wash the cylinder and its fittings to remove mud, dirt, and grease.

(2) Move the clam cylinder controls to relieve pressure in the circuit.

(3) Disconnect the line to the cylinder rod end.

*Note.* Cap or plug ports and openings as soon as they are disconnected.

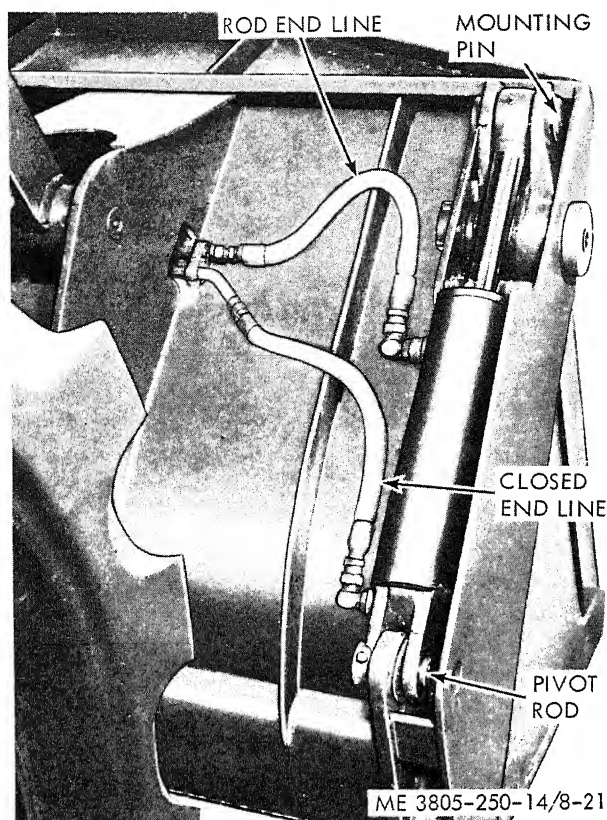


Figure 8-21. Clam cylinder, removal and installation.

(4) Disconnect the line to the cylinder closed end.

(5) Support the cylinder so that it does not fall when the mounting pins are removed.

(6) Remove cotter key and clevis pin and slide mounting pin from rod end eye.

(7) Remove cotter key and clevis pin and remove pivot rod from closed end eye.

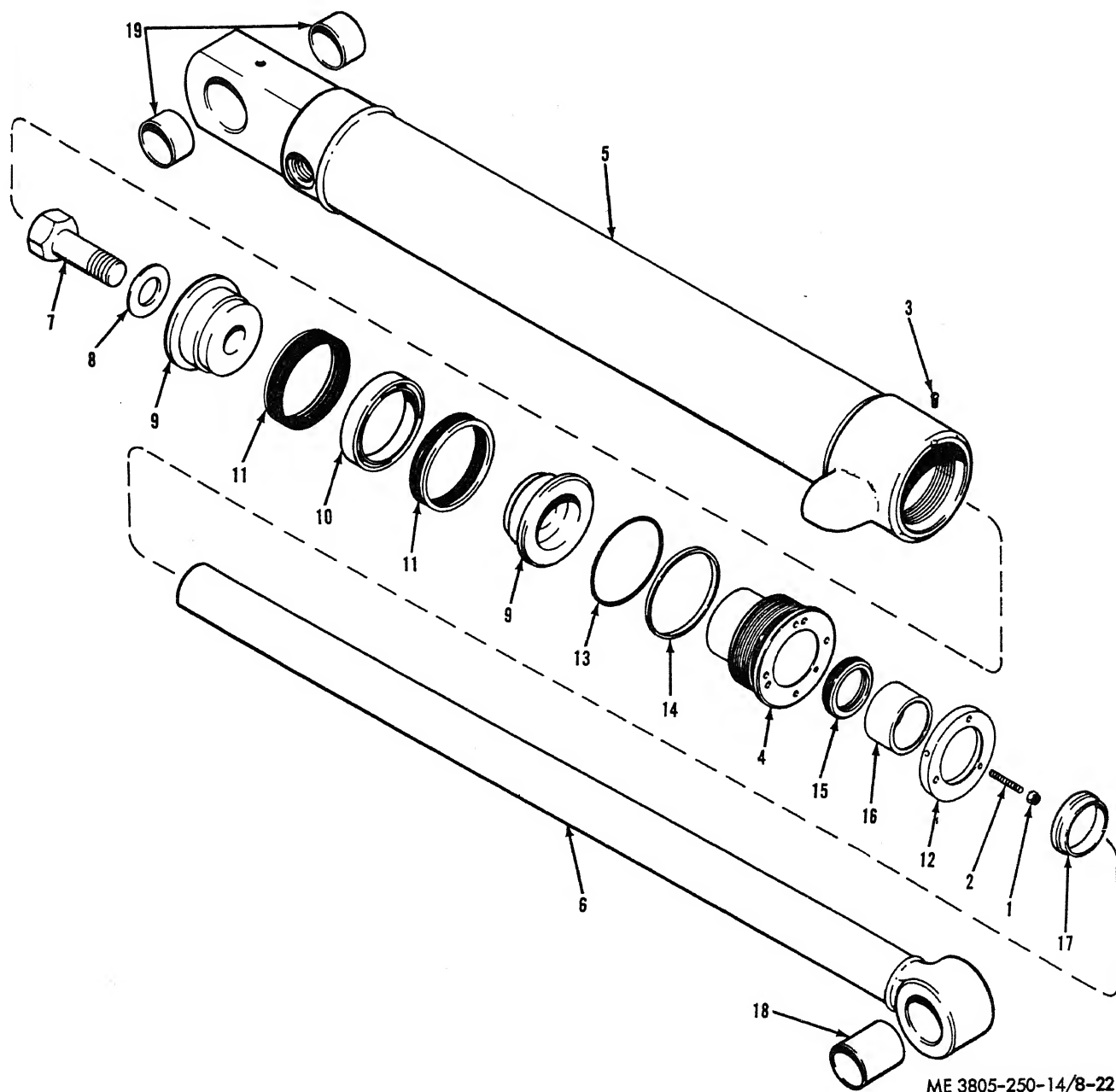
(8) Place the cylinder on a clean work bench and drain hydraulic fluid.

*d. Disassembly of Lift, Tilt, and Clam Cylinders*  
Refer to figure 8-22.

*Note.* Figure 8-22 is an exploded view of the tilt cylinder. For disassembly purposes, the lift and clam cylinders are the same, with exceptions noted.

(1) Place the cylinder in a vise, using care not to distort the tube. Remove adjusting nuts (1) and setscrews (2), and slide the flange (12) away from the gland so that a spanner wrench can be applied to the gland.

(2) Remove self-tapping screw (3) securing the gland (4) to the tube (5).

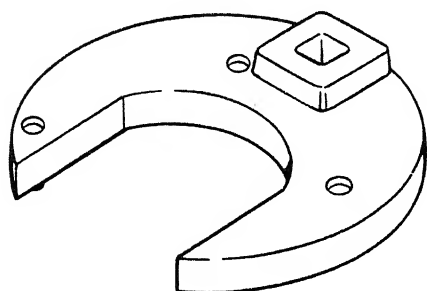


ME 3805-250-14/8-22

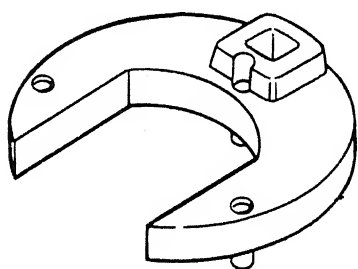
- |                       |                      |                    |
|-----------------------|----------------------|--------------------|
| 1. Adjusting nut      | 7. Self-locking bolt | 14. Backup ring    |
| 2. Setscrew           | 8. Washer            | 15. Wiper ring     |
| 3. Self-tapping screw | 9. Piston            | 16. Female adapter |
| 4. Gland              | 10. Center ring      | 17. Packing        |
| 5. Tube               | 11. Packing          | 18. Bushing        |
| 6. Piston rod         | 12. Flange           | 19. Bushing        |
|                       | 13. Seal             |                    |

Figure 8-22. Lift, tilt, and clam cylinders, exploded view.

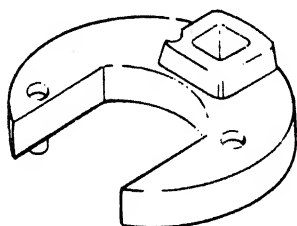
(3) Refer to figure 8-23 and select the appropriate spanner wrench for unscrewing the gland assembly.



D-44116 LIFT CYLINDER-SPANNER WRENCH



D-44115 TILT CYLINDER SPANNER WRENCH



D-44112 CLAM CYLINDER SPANNER WRENCH

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Figure 8-23. Hydraulic cylinders spanner wrenches.

(4) Carefully slip the piston rod (6, fig. 8-22) and gland assembly from the tube.

**Caution:** Do not allow the rod to cock during removal. Internal parts could be damaged.

(5) Place the piston rod eye in a vise and remove the self-locking bolt (7) and washer (8). Remove from vise.

*Note.* Bolt (7) has been tightened to 1000 to 1200 pound-feet.

(6) Remove the piston halves (9) from the piston rod. If piston halves remain together, separate them. Remove the center ring (10) and chevron packing and end rings (11).

(7) Remove the gland assembly from the piston rod, using a soft hammer if necessary. Remove the flange (12) from the piston rod.

(8) Remove seal (13). On tilt and clam cylinders, remove backup ring (14). Remove the wiper ring (15) from the flange.

(9) Remove the female adapter (16) and packing (17) from the gland.

(10) If necessary, remove bushings (18 and 19).

*e. Cleaning, Inspection and Repair.*

(1) Carefully clean all parts in solvent and dry with compressed air.

(2) Inspect parts for damage and wear and replace as necessary.

(3) Shine a light into the cylinder tube. Replace the tube if it is grooved, scored, or damaged. Severe scoring could indicate contaminated hydraulic fluid.

(4) Inspect the piston rod for alignment. Replace rod if it is bent. Refer to subparagraph for rod eye replacement.

(5) Replace bushings if they are worn or out-of-round.

(6) Before reassembly, remove any minor nicks or scratches on the rod or in the cylinder tube with medium grit emery cloth, polishing with a rotary motion.

*f. Reassembly of Lift, Tilt and Clam Cylinders*  
Refer to figure 8-22.

(1) Assemble the gland (4) as follows:

(a) On tilt and clam cylinders, install backup ring (14). Install a lightly lubricated rod seal (13) inside the gland (4).

(b) Install the packing assembly (15) in the large end of the gland with the vees facing toward the outside of the gland. Install the packing (17) in the flange (12). Lubricate the packing and slide onto the piston rod (6).

(c) Lubricate and install the gland assembly



on the piston rod (6). If necessary, the gland may be driven onto the rod with a soft hammer.

(2) Assemble piston (9) as follows:

(a) Dip the packing parts in hydraulic fluid. Install the male adapter and nylon, neoprene, then nylon chevron rings (11) in each piston half. The vee of the rings must point to the center of the piston. Refer to figure 8-24.

(b) Install the center ring (10) and fit the two piston halves together. Install the piston or piston rod (6).

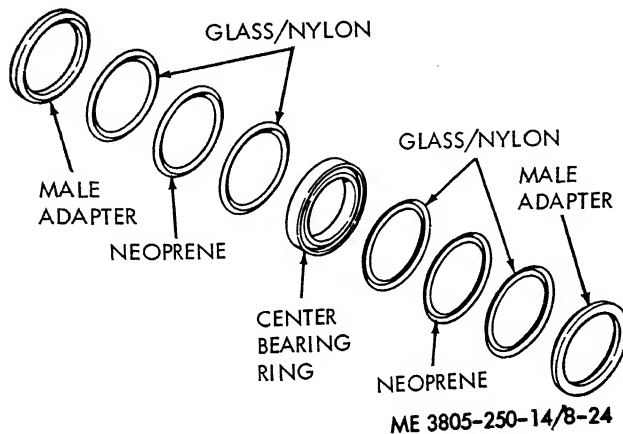


Figure 8-24. Piston packing installation.

(c) Secure the piston packing with washer (8) and self-locking bolt (7). Tighten to 1000 to 1200 pound-feet.

(3) Lubricate the cylinder tube and piston packing thoroughly. Keeping the piston rod aligned with the cylinder tube, begin to slide the piston into the cylinder tube (5). After the piston has started into the smooth surface of the tube, slide the gland into position. Place a rod through the piston rod eye and work the piston into the tube.

(4) Screw the gland into the tube and, using an appropriate spanner wrench (fig. 8-23), tighten to 100 to 200 pound-feet, until the self-tapping holes align. Take care not to cut or pinch the preformed packing or backup ring in the gland.

(5) If a new gland or tube is being installed, drill a new hole for the self-tapping screw, half in the tube and half in the gland. Do not drill in line with the spanner wrench holes. Use a No. 26 drill and drill approximately 5/16-inch deep.

(6) Install new bushings (18 and 19) if removed.

*g. Replacement of Piston Rod Eye and Yoke Assemblies.* Refer to paragraph 7-30.

*h. Lift, Tilt and Clam Cylinder Installation.*

(1) Install the cylinder by reversing the removal procedure.

(2) Start the engine and operate the bucket through several complete cycles to bleed the system.

(3) Check and add oil as necessary.

(4) Check the cylinders for leaks. If necessary, tighten the adjusting nuts at the cylinder gland.

## Section IV. PNEUMATIC COMPONENTS

### 8-14. General

*a.* Pneumatic components consist of an air compressor and governor, alcohol evaporator, main air reservoir, pressure regulator, pressure protection valve, and auxiliary air reservoir. The system provides air pressure to operate the brakes, sound the horn, and pressurize the hydraulic and steering systems.

*b.* Compressed air is delivered to the main reservoir and stored. A one-way check valve prevents air from returning to the compressor. The governor maintains reservoir pressure between 100 and 120 psi. In case of governor malfunction, a safety valve will open at 150 psi, preventing further increase in pressure.

*c.* The main reservoir supplies air to the brake air valve, air horn, and air pressure gage. When reservoir air pressure exceeds 65 psi, air is also directed to the auxiliary air reservoir.

*a.* Air from the auxiliary air reservoir pressurizes the hydraulic and steering systems. When main reservoir pressure drops below 65 psi, the pressure protection valve closes to maintain pressure in the auxiliary reservoir. Air from the auxiliary reservoir passes through the air pressure regulator valve which reduces air pressure to the hydraulic reservoir to 13 to 19 psi.

*e.* Refer to figure 1-5 for a schematic diagram of the air system.

### 8-15. Air Compressor

*a. Removal.* Refer to figure 8-25.

(1) Block the wheels and apply the parking brake.

(2) Remove the right engine side panel.

(3) Drain the air reservoirs (para 3-19).

(4) Disconnect the inlet hose, outlet hose, governor outlet line, oil inlet line and oil outlet line



from the air compressor. Disconnect lines to the alcohol evaporator. Cap or plug lines and fittings as soon as they are disconnected.

(5) Loosen the adjustment bolts and slides the compressor inward to release the belt.

(6) Remove the mounting bolts, and remove the air compressor from the loader.

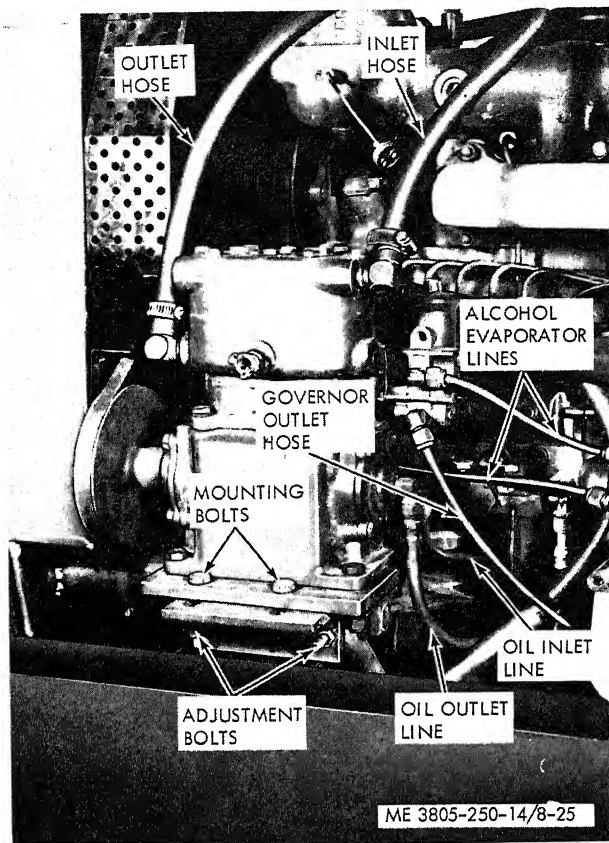


Figure 8-25. Air compressor, removal and installation.

#### *h. Disassembly.*

*Note.* Clean the air compressor thoroughly with solvent before disassembly. Remove the bolts securing the base plate to the bottom of the crankcase.

(1) Remove and disassemble the governor as follows:

(a) Remove two nuts (1, fig. 8-26), sleeves (2) and elbows (3) connecting the tube (4) from the governor to the compressor.

(b) Remove two bolts (5), nuts (6) and lockwashers (7) securing the governor to the air compressor.

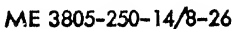
(c) Unscrew the top cover (8) and remove the retaining ring (9).

(d) To remove the adjusting screw and spring assembly from the governor body, remove locknut (10), upper spring seat (11), pressure setting spring (12), top half of the lower spring seat (13), spring guide (14), and bottom half of the lower spring seat (15) from the adjusting screw (16).

(e) Remove the exhaust stem (17) and its spring (18) from the piston. Remove washer (19) and discard preformed packing (20).

(f) Invert the body and tap lightly until the piston (21) falls out. Remove the inlet/exhaust valve spring (22) and valve (23) from the piston. Discard the piston preformed packings (24).

(g) Remove and discard the unloader and reservoir port filters (25) from the housing (26).



- Figure 8-26. Governor, exploded view.*

(b) Bend back the prongs on lockwasher (16) and remove the connecting rod bolts (17) and bearing caps (18).

(c) Push the piston (19) and connecting rod (20) out through the top of the cylinder block. Replace each bearing cap (18) and bearing (21) on its respective connecting rod.

(d) Remove the piston rings (22) from the pistons. If the pistons are to be removed from the connecting rods, remove wrist pin lockwires (23) and press the wrist pins (24) from the pistons and connecting rods. Remove bushings (25).

(e) Remove six bolts (26) and lockwashers (27) securing the cylinder block to the crankcase. Discard gasket (28).

(f) Remove two bolts (29) and lockwashers (30) securing the inlet adapter (31) to the block. Remove strainer (32), gasket (33) and flange (34).

(g) Remove the two inlet valve springs (35), guides (36), and inlet valve (37) from the top of the block.

(h) Remove unloader spring (38), spring saddle (39), and spring seat (40) from the block.

(i) Apply air pressure to the unloader port and lift the unloader pistons (41), guides (42) and

plungers (43) from the housing. Remove backup ring (44) and preformed packing (45).

(j) Remove inlet valve seats (46) if they are to be replaced.

(k) Remove plugs (47 and 48) from body.

(4) Disassembly crankcase as follows:

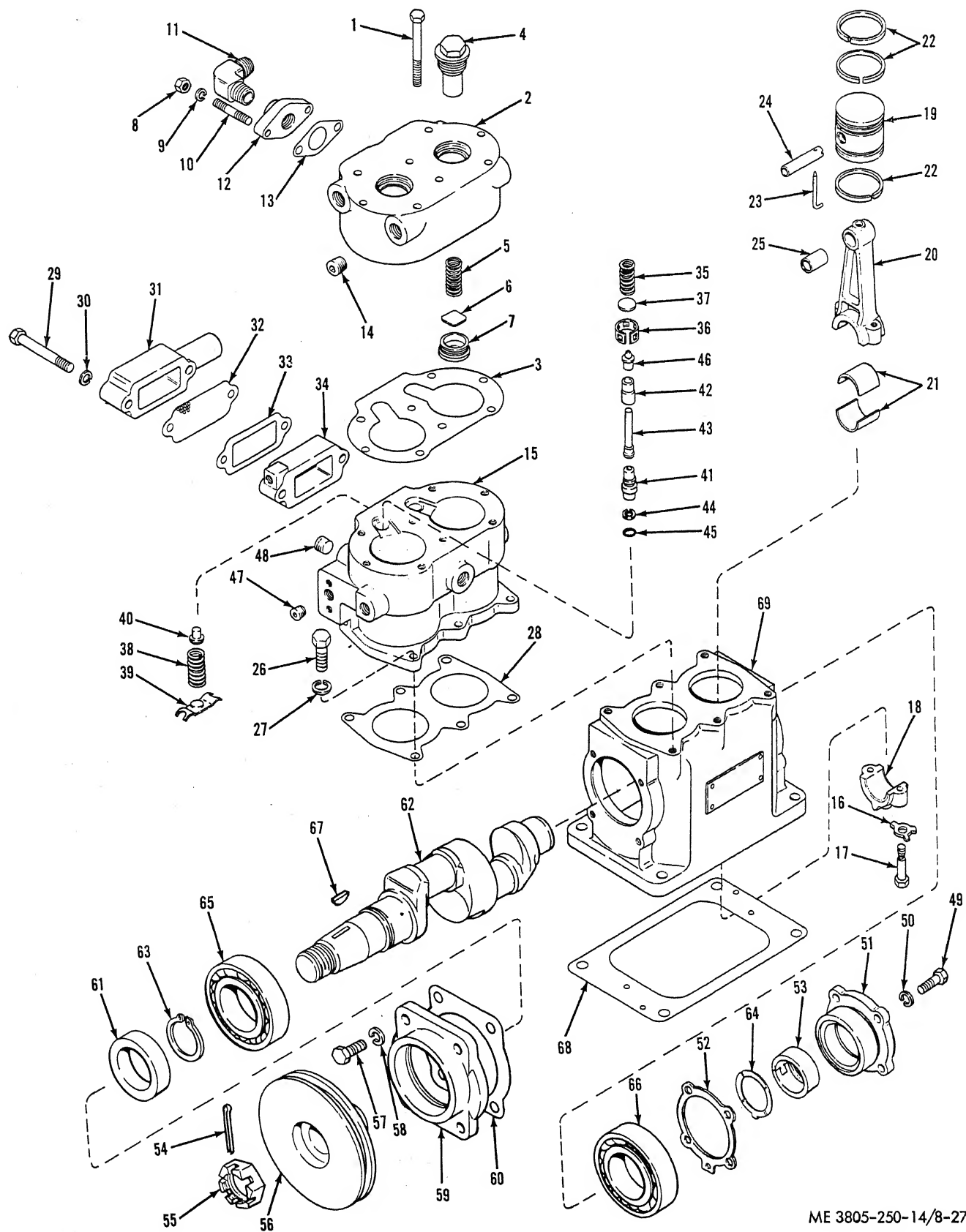
(a) Remove four capscrews (49, fig. 8-28) and lockwashers (50) securing the rear cover (51) to the housing. Discard gasket (52) and remove bushing (53) from the cover.

(b) Remove cotter key (54) and slotted nut (55) from the end of the crankshaft. Remove hub (56).

(c) Remove four front cover mounting bolts (57) and lockwashers (58). Remove cover (59) and discard gasket (60). Remove seal (61) from front cover.

(d) Press the crankshaft (62) from the crankcase, and remove bearing retaining ring (63) and thrust washer (64) from crankshaft. Remove bearings (65 and 66) from shaft. Remove key (67).

(e) Scrape gasket (68) from the bottom of compressor housing (69).



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Figure 8-27. Air compressor, exploded view.

KEY to fig. 8-27:

- |                    |                       |
|--------------------|-----------------------|
| 1. Bolt            | 35. Spring            |
| 2. Cover           | 36. Guide             |
| 3. Gasket          | 37. Inlet valve       |
| 4. Nut             | 38. Spring            |
| 5. Spring          | 39. Saddle            |
| 6. Valve           | 40. Seat              |
| 7. Valve seat      | 41. Unloader piston   |
| 8. Nut             | 42. Guide             |
| 9. Lockwasher      | 43. Plunger           |
| 10. Stud           | 44. Backup ring       |
| 11. Elbow          | 45. Preformed packing |
| 12. Fitting        | 46. Seat              |
| 13. Gasket         | 47. Plug              |
| 14. Plug           | 48. Plug              |
| 15. Cylinder block | 49. Capscrew          |
| 16. Lockwasher     | 50. Lockwasher        |
| 17. Bolt           | 51. Cover             |
| 18. Bearing cap    | 52. Gasket            |
| 19. Piston         | 53. Bushing           |
| 20. Connecting rod | 54. Cotter key        |
| 21. Bearing        | 55. Slotted nut       |
| 22. Piston ring    | 56. Hub               |
| 23. Lockwire       | 57. Bolt              |
| 24. Wrist pin      | 58. Lockwasher        |
| 25. Bushing        | 59. Cover             |
| 26. Bolt           | 60. Gasket            |
| 27. Lockwasher     | 61. Seal              |
| 28. Gasket         | 62. Crankshaft        |
| 29. Bolt           | 63. Retaining ring    |
| 30. Lockwasher     | 64. Thrust washer     |
| 31. Inlet adapter  | 65. Bearing           |
| 32. Strainer       | 66. Bearing           |
| 33. Gasket         | 67. Key               |
| 34. Flange         | 68. Gasket            |
|                    | 69. Housing           |

*c. Cleaning, Inspection and Repair.*

(1) Clean, inspect, and repair cylinder head as follows:

(a) Remove carbon deposits from cover and body.

(b) Inspect body for cracks or other damage.

(c) Check discharge valves for wear. Replace valves if possible, or reclaim by lapping with crocus cloth.

(d) Check discharge valve seats for wear. If wear is excessive, replace the seats. If wear is slight, lap the seats.

(e) Replace the discharge valve spring, valve guides and valves.

(f) Inspect the discharge valve stops on the cylinder head cover. The stops should not be peened. Replace the cover if the stops are excessively damaged.

(2) Clean, inspect, and repair the governor as follows:

(a) Clean all metal parts in solvent.

(b) Inspect the body for cracks or other damage. Make sure all air passages are open.

(c) Check piston for cracks and corrosion.

(d) Check springs for cracks, corrosion, and distortion and replace as necessary.

(3) Clean, inspect, and repair cylinder block as follows:

(a) Inspect the cylinder block for cracks and broken lugs.

(b) Clean unloader piston bores of dirt, grease and rust.

(c) Check inlet valves for wear. Replace if possible regardless of wear. If wear is slight, valves may be reclaimed by lapping with crocus cloth.

(d) Check inlet valve seats for wear. Replace if wear is excessive, or repair by lapping if wear is slight.

(e) Cylinder walls should not be scored or out-of-round by more than 0.0002 inch or be tapered more than 0.003 inch. Clearance between the piston and cylinder wall should be between 0.002 and 0.004 inch.

(f) Inspect pistons for scores, cracks, or enlarged piston ring grooves, and replace as necessary.

(g) Check the fit of the wrist pin in piston and connecting rod bushing. Pin should fit with a light press. If the wrist pins are loose and worn, replace the wrist pins and pistons. Replace wrist pin lockwire.

(h) Replace unloader parts. The new unloader pistons should have a free sliding fit in the unloader piston bores.

(4) Clean, inspect, and repair crankcase as follows:

(a) Check for cracks and broken lugs on the crankcase and end covers. Check crankcase oil passages and make sure they are open.

(b) Check crankshaft screw threads, keyways, tapered ends, and all machined and ground surfaces for wear, scores, cracks, or other damage.

(c) Check oil passages in crankshaft to make sure they are open and clean.

(d) Check crankshaft ball bearings for wear or flat spots. Replace if damaged.

**d. Reassembly.**

(1) Assemble the cylinder block as follows:

(a) Lubricate unloader pistons and piston bores with a liquid silicone lubricant. Do not lubricate if a new unloader kit is being installed.

(b) Install backup ring (44, fig. 8-27) and preformed packing (45) and position unloader pistons (41) in their bores, using care not to damage the packings.

(c) Position the unloader plungers (43) in their guides (42) and slip them into the housing over the tops of the pistons.

(d) Install the unloader spring seat (40) in the cylinder block.

(e) Position the unloader saddle (39) between the unloader piston guides so that its forks are centered on the guides.

(f) Install the unloader spring (38), making sure it is seated on both the block and saddle seats.

(g) Install the inlet valve seats (46) in the cylinder block if they were removed. Position and install the inlet valve guides (36) and place the inlet valves (37) into their guides. Check the guides for a loose sliding fit with the valves.

(h) Position the inlet valve spring (35) on the cylinder head. If necessary, hold the spring in position with a small amount of grease.

(2) Assemble the crankcase as follows:

(a) Align the marks made on the cylinder block and crankcase during disassembly. Position a new gasket (28, fig. 8-27) and the cylinder block (15) on the crankcase and secure with six bolts (26) and lockwashers (27).

(b) Press the crankshaft ball bearings (65 and 66) onto the crankshaft (62) and install bearing retaining ring (63) and thrust washer (64). Align the crankshaft and bearings with the crankcase and press into the crankcase.

(c) Press a new oil seal (61) into the front cover (59) and bushing (53) into rear cover (51). Position a new gasket (60) and front cover (59) over the crankshaft, being careful not to damage the oil seal. Secure the cover with four bolts (57) and lockwashers (58). Install key (67) and hub

(56) and secure with slotted nut (55) and cotter key (54).

(d) Secure new gasket (52) and rear cover (51) to the crankcase with four bolts (49) and lockwashers (50).

(e) Assemble pistons (19) and connecting rods (20) as follows:

1. Install bushing (25). If new wrist pin bushings are to be used, press them into connecting rods so that the oil hole in the bushing aligns with the oil hole in the rod. Ream the bushings to provide between 0.0001 and 0.0006 inch clearance on the wrist pin.

2. Position the connecting rod in the piston and press in the wrist pin (24). Make sure the lock hole in the piston and wrist pin are aligned. Install new lockwire (23), snapping the short end into the hole in the piston skirt.

3. Install new piston rings (22), ensuring that ring gaps are staggered. Refer to figure 8-28 for correct installation.

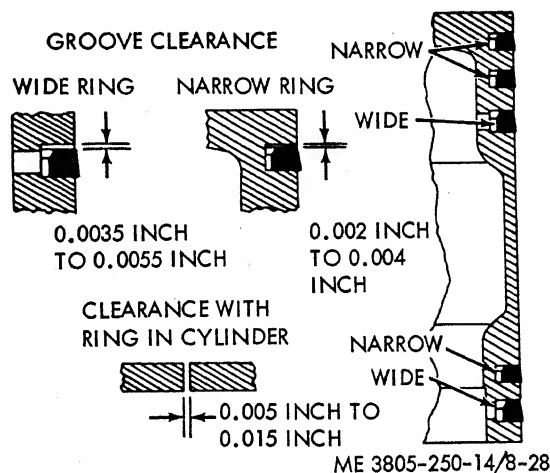


Figure 8-28. Piston ring installation.

4. Place a new connecting rod bearing (21, fig. 8-27) in the connecting rod and rod cap (18).

5. Lubricate the piston and rod assembly with clean oil.

(f) Turn the crankshaft to position one connecting rod journal at bottom dead center. Insert the connecting rod and piston through the top of this cylinder using a piston-ring compressor. Align the connecting rod over the crankshaft and seat the rod on the crankshaft. Install bearing cap (18), lockwasher (16) and connecting rod bolt (17). Tighten bolts evenly to  $100 \pm 15$  pound-inches and bend the lockwasher prongs back against the bolt heads. Repeat this procedure for the remaining piston and connecting rod.

(g) Install flange (34), gasket (33), strainer (32), gasket and adapter (31) with two bolts (29) and lockwashers (30).

(h) Install plugs (47 and 48).

(3) Assemble and install the cylinder head as follows:

(a) Install the discharge valve seats (7), in the cylinder head if they were removed.

(b) Insert spring (5) and discharge valves (6) into the guides. Check for a loose sliding fit.

(c) Install the discharge valve nuts (4) in the cylinder head.

(d) Install a new cylinder head cover gasket (3) and cover (2), ensuring that the valve stops are properly positioned inside the discharge valve springs. Secure cover with five bolts (1) and tighten evenly.

(e) Install a new gasket (13) and install fitting (12). Secure with two studs (10), bolts (8) and lockwashers (9). Install elbow (11). Install plug (14).

(4) Assemble and install the governor as follows:

(a) Lubricate the lower body bore, top of piston, piston grooves, new preformed packings, and pressure setting spring guide with a liquid silicone lubricant.

(b) Install new preformed packings (24, fig. 8-26) in the top and bottom of the piston (21).

(c) Place the inlet/exhaust valve (23) in the bottom of the piston, and install the valve spring (22) with the small end against the valve. Push the spring down until the large end snaps into the groove in the piston.

(d) Position the exhaust stem spring (18), washer (19), and preformed packing (20) on the exhaust stem (17) and carefully press the stem into the stem bore in the piston.

(e) Install new reservoir and unloader port filters (25) and place the piston assembly in the governor body.

(f) Position the bottom half of the lower spring seat (15), spring guide (14), top half of the lower spring seat (13), and the pressure setting spring (12) on the adjusting screw (16).

(g) Install the upper spring seat (11) on the adjusting screw, screwing the upper spring seat down until the dimension from the top of the seat to

the bottom of the adjusting screw head is approximately 1-7/8 inches.

(h) Make sure the exhaust stem (17) is still in place in the piston, and install the adjusting screw assembly and retaining ring (19).

(i) Install the governor to the air compressor with two bolts (5), nuts (6) and lockwashers (7). Install tube (4) with elbows (3), sleeves (2) and nuts (1).

(j) Screw on the cover (8).

(5) Install a new gasket (68, fig. 8-27) and secure the compressor base plate with bolts.

#### *e. Installation.*

(1) Install the air compressor in the reverse order of removal (subpara b).

(2) Adjust the belt tension (para 4-65).

### **8-16. Air Reservoirs**

#### *a. Main Air Reservoir.*

##### *(1) Removal.*

(a) Block the wheels or apply the parking brake.

(b) Open the drain cock on the bottom of the reservoir.

(c) Clean the reservoir and lines of dirt and grease.

(d) Disconnect the line from the air compressor to the check valve on the rear of the reservoir (fig. 8-29).

(e) Disconnect the air line from the air compressor governor to the tee fitting on the front of the reservoir.

(f) Disconnect the air line from the brake treadle valve to the tee fitting on the front of the reservoir.

(g) Remove two mounting clamp nuts, lockwashers and bolts.

(h) Remove the upper mounting clamp mounting nut, lockwasher and bolt and remove the upper mounting clamp.

(i) Slide the reservoir from the bottom mounting clamp.

##### *(2) Installation.*

(a) Install the reservoir in the loader by reversing the removal procedure.

(b) Close the drain cock and start the engine to pressurize the brake system.

(c) Check the reservoir and lines for leaks.

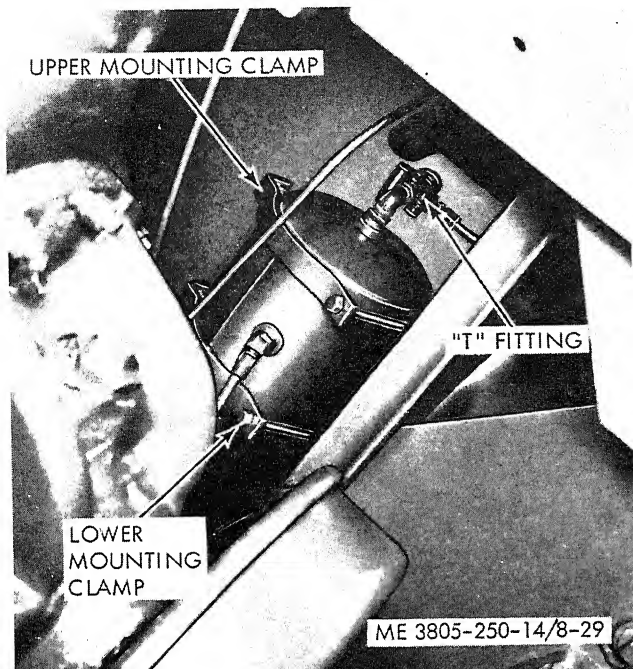


Figure 8-29. Main air reservoir.

**b. Auxiliary Air Reservoir.**

**(1) Removal.** Refer to figure 8-30.

(a) Block the wheels or apply the parking brake.

(b) Open the drain cock on the extension from the reservoir.

(c) Clean the reservoir and lines of dirt and grease.

(d) Disconnect the air line to the pressure protection valve.

(e) Disconnect the air line to the shutoff valve at the hydraulic reservoir.

(f) Disconnect the drain valve extension from the reservoir.

(g) Remove two mounting clamp nuts, lockwashers, and bolts from each clamp.

(h) Remove nut and lockwasher and loosen the mounting clamp retaining bolts.

(i) Rotate the reservoir  $\frac{1}{4}$  turn and slide from the loader.

**(2) Installation.**

(a) Install the reservoir by reversing the removal procedure.

(b) Close the drain cock and start the engine to pressurize the brake system.

(c) Check the reservoir and lines for leaks.

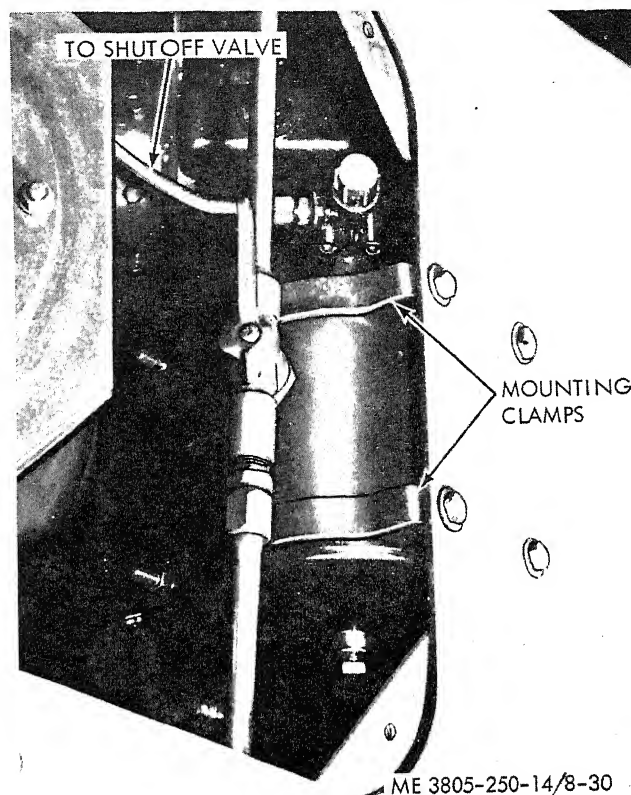


Figure 8-30. Auxiliary reservoir.

**8-17. Safety Valve**

*Note.* The safety valve should be disassembled and cleaned once a year.

**a. Removal.**

(1) Open the drain cock on the main air reservoir to depressurize the brake system.

(2) Unscrew the safety valve as an assembly from the main air reservoir.

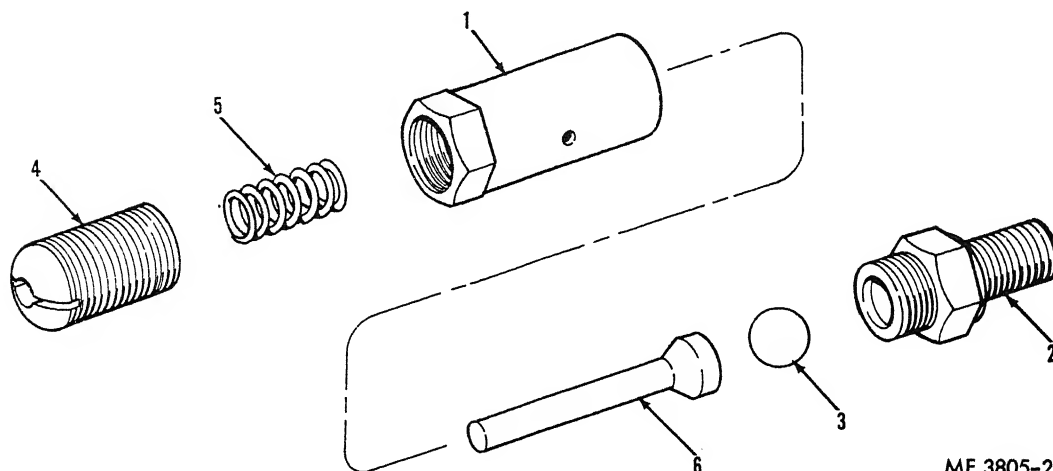
**b. Disassembly.** Refer to figure 8-31.

(1) Unscrew the spring cage (1) from the valve body (2).

(2) Lift the ball valve (3) from the body.

(3) Remove adjusting screw (4), spring (5) and release pin (6) from the spring cage.





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1. Spring cage
2. Valve body
3. Ball valve
4. Adjusting screw
5. Spring
6. Release pin

Figure 8-31. Safety valve, exploded view.

*c. Cleaning, Inspection and Repair.*

- (1) Clean all components with solvent.
- (2) Check ball valve for pitting and scratches. Replace ball valve if damaged.
- (3) Check the body and spring cage for cracks.
- (4) Ensure that the exhaust port in the spring cage is open.

*d. Reassembly.* Assemble valve by reversing the disassembly procedure.

*e. Test and Adjustment.*

*Note.* Check safety valve setting with an air pressure regulator capable of regulating air pressure to 150 psi.

- (1) Attach an air line from the pressure regulator to the safety valve.
- (2) Adjust air pressure regulator to 150 psi.
- (3) Apply pressure to the safety valve and perform one of the following adjustments.

(a) If air passes through the safety valve, turn the adjusting screw clockwise until air stops flowing. Then turn the adjusting screw counterclockwise until the air starts to flow. Tighten the adjusting screw locknut and ensure that air still flows through the valve.

(b) If air does not pass through the safety valve, turn the adjusting screw counterclockwise until air passes through the safety valve. Tighten adjusting screw locknut and ensure that air still flows through the valve.

*f. Installation.*

- (1) Install valve by reversing the removal procedure.

- (2) Close the drain valve on the main air reservoir and start the engine to pressurize the brake system.

- (3) Check for leakage at the exhaust port on the safety valve.

- (4) If leakage exceeds a three-inch bubble in three seconds, replace the valve.

## 8-18. Pressure Protection Valve

*a. Removal.*

- (1) Block the loader or hold with parking brake.

- (2) Open the drain cocks on the main and auxiliary air reservoirs.

- (3) Clean lines and fittings on the valve end of the auxiliary reservoir.

- (4) Disconnect air line from the valve and remove valve from the auxiliary reservoir. Cap or plug openings.

*b. Disassembly.* Refer to figure 8-32.

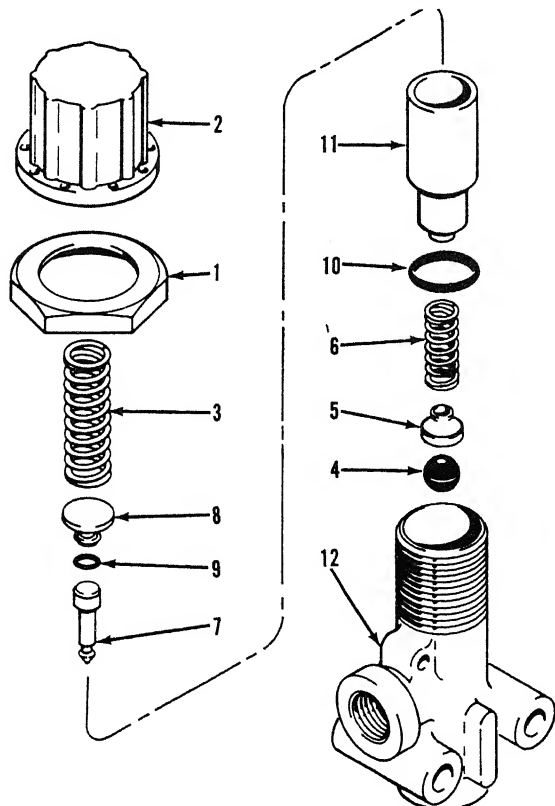
- (1) Loosen locknut (1) and remove adjusting cap (2) and locknut.

- (2) Remove pressure regulating spring (3) and piston assembly from valve body.

- (3) Remove inlet valve (4), valve retainer (5), and spring (6) from inlet valve stem.

- (4) Push valve stem (7) against piston plug (8) to unseat plug. Remove plug and valve stem. Remove preformed packing (9) from the piston plug.

- (5) Remove preformed packing (10) from piston (11).



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- |                |                       |
|----------------|-----------------------|
| 1. Locknut     | 7. Stem               |
| 2. Cap         | 8. Piston plug        |
| 3. Spring      | 9. Preformed packing  |
| 4. Inlet valve | 10. Preformed packing |
| 5. Retainer    | 11. Piston            |
| 6. Spring      | 12. Body              |

Figure 8-32. Pressure protection valve, exploded view.

**c. Cleaning, Inspection and Repair.**

- (1) Clean metal and plastic components with solvent. Wipe inlet valve with dry cloth.
- (2) Inspect valve body piston, and inlet valve body for cracks and wear.
- (3) Check springs for rust and corrosion.
- (4) Check inlet valve for cracks, excessive wear, and deterioration.

- (5) Replace defective components.

**d. Reassembly.** Refer to figure 8-32.

- (1) Lubricate piston, valve body bore and preformed packings with a light clean oil.

- (2) Install preformed packing (10) on piston (11) and preformed packing (9) on piston plug (8).

- (3) Position inlet valve stem (7) in piston as follows:

- (a) Place valve spring (6) and valve retainer (5) on valve stem.

- (b) Hold the valve stem in place and depress the spring. Position inlet valve (4) on the valve stem and release the spring.

- (4) Seat piston plug (8) in the piston.

- (5) Insert the piston assembly into the valve body and position the pressure regulating spring (3) in the piston.

- (6) Install adjusting cap (2) and locknut (1).

**e. Test and Adjustment.**

*Note.* Adjust valve setting with an air pressure regulator capable of regulating air pressure to 65 psi.

- (1) Attach an air line from the pressure regulator to the inlet port of the pressure protection valve.

- (2) Apply 65 psi air pressure to the pressure protection valve. Adjust valve according to one of the following:

- (a) If air passes through the valve, turn the adjusting cap clockwise (tighten cap) until the air stops flowing. Then turn cap counterclockwise until air starts flowing. Tighten locknut and ensure that air still passes through the valve.

- (b) If air does not pass through the valve turn the adjusting cap counterclockwise (loose cap) until air flows through the valve. Tighten the locknut and ensure that air still passes through the valve.

**f. Installation.**

- (1) Install the valve on the auxiliary reservoir and connect air line.

- (2) Pressurize the air system and check for leaks.

**8-19. Air Regulator Valve**

**a. Removal.**

- (1) Close the shutoff valve in the inlet line to the regulator. Slowly remove the hydraulic reservoir dipstick to depressurize the reservoir.

- (2) Clean the regulator and air lines and fittings.

- (3) Disconnect the outlet air line and remove the regulator from the shutoff valve. Cap or plug openings.

**b. Disassembly.** Refer to figure 8-33.

- (1) Unscrew bonnet (1) from the body (2).

*Note.* Do not remove the knob unless it is exceptionally hard to turn.

- (2) Remove mounting nut (3) from bonnet and remove screw (4), button (5), spring (6), knob (7) and three tumblers (8).

- (3) Unscrew lower piston (9) from bonnet, and remove spring assembly (10) and upper piston (11). Discard preformed packings (12), (13) and (14).

- (4) Remove coupling (15) and adjusting screw (16) from upper piston. Discard preformed packing (17).

(5) Remove preformed packing (18) from bonnet and discard.

(6) Remove pilot valve (19), valve spring (20) and spring (21) from body.

(7) Invert the body and unscrew valve guide plug (22), spring (23), regulator valve (24) and screen (25). Discard preformed packings (26, 27, 28 and 29).

#### c. Cleaning, Inspection and Repair.

(1) Clean all components with solvent.

(2) Inspect valve body bores for grooves, deep scratches, or excessive wear.

(3) Inspect valves for grooves or other defects. Replace damaged valves.

(4) Inspect springs for cracks and weakness and replace as necessary.

(5) Inspect piston halves for grooves, nicks, scratches and other damage.

(6) Replace all preformed packings.

#### d. Reassembly. Refer to figure 8-33.

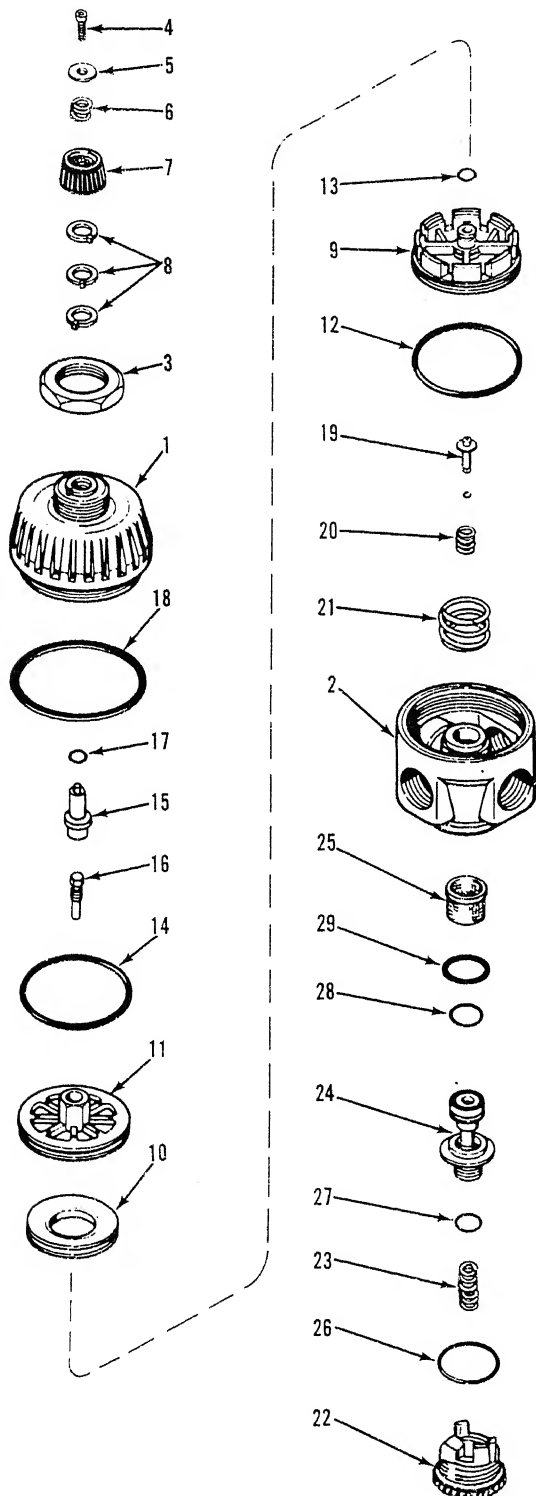
(1) Install preformed packing (14) on upper piston (1) and preformed packing (12) on lower piston (9). Install adjusting screw (16) in upper piston.

(2) Install preformed packing (17) and coupling (15) in bonnet.

(3) Install upper piston assembly to bonnet, rotating the piston to align the adjusting screw with the coupling.

(4) Install spring assembly (10), preformed packing (13) and lower piston (9).

(5) Install preformed packings (28 and 29) on valve (24), preformed packing (27) on spring (23), and preformed packing (26) on valve guide plug (22).



#### KEY to fig. 8-33:

1. Bonnet
2. Body
3. Mounting nut
4. Screw
5. Button
6. Spring
7. Knob
8. Tumbler
9. Lower piston
10. Spring assembly
11. Upper piston
12. Preformed packing
13. Preformed packing
14. Preformed packing
15. Coupling
16. Screw
17. Preformed packing
18. Preformed packing
19. Pilot valve
20. Spring
21. Spring
22. Plug
23. Spring
24. Regulator valve
25. Screen
26. Preformed packing
27. Preformed packing
28. Preformed packing
29. Preformed packing

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(6) In the bottom of the body install screen (22), regulator valve (24), spring (23), and valve plug (22).

(7) Position spring (20) on pilot valve (19), install valve (19) and springs (20 and 21) on top of regulator valve (24).

(8) Install preformed packing (18) on the nut and screw bonnet into the valve body.

#### **. Installation.**

(1) Install the regulator on the shutoff valve and connect the outlet air line.

(2) Open the shutoff valve and adjust regulator as described in subparagraph f.

**Adjustment.** Adjust regulator to maintain 16 psi in the hydraulic reservoir as follows:

(1) Start the engine and run at low idle speed.

**Note.** Do not run engine at a higher speed. A false pressure setting will be obtained.

(2) Loosen the Allen screw one turn. Hold the knob firmly with an Allen wrench and turn the adjusting knob until the gage at the hydraulic reservoir indicates 16 psi.

(3) Hold the adjusting knob firmly and tighten the Allen screw.

## **8-20. Clutch Cutout Control Valve**

### **a. Removal.**

**Note.** The clutch cutout control valve is located beneath the floorboard directly above the neutral start switch.

(1) Remove accumulated dirt and grease from air line fittings at the valve and disconnect air lines. Cap or plug openings.

(2) Remove the boot from the valve.

(3) Remove the valve retaining nut and remove the valve from its bracket.

### **b. Disassembly.** Refer to figure 8-34.

(1) Unscrew remaining mounting nut (1) from adapter.

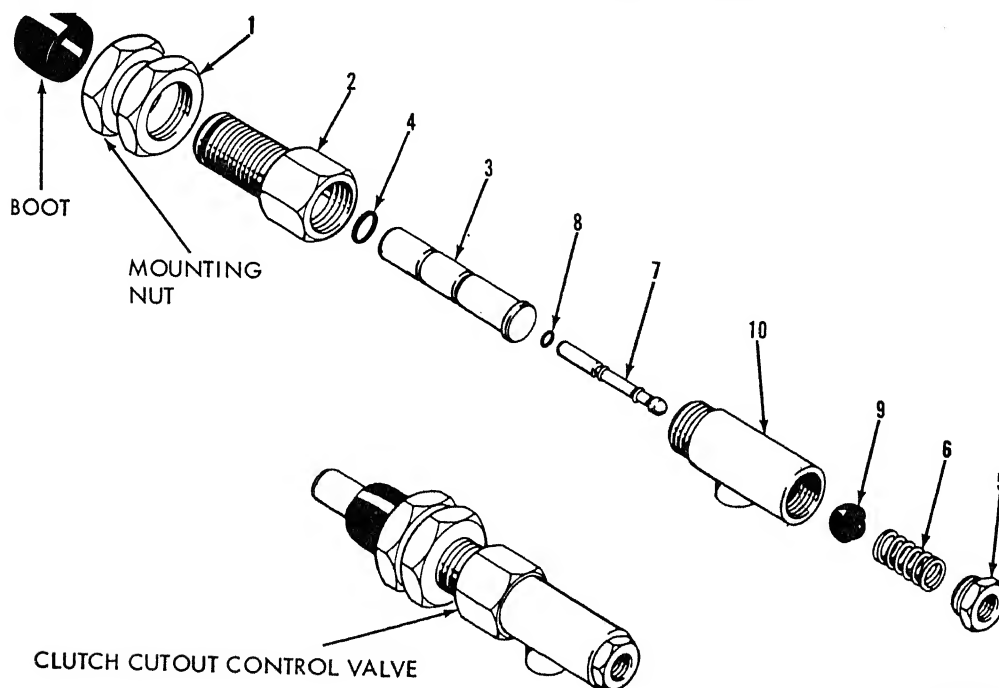
**Note.** The boot and one mounting nut are removed when the valve is taken from the loader.

(2) Unscrew adapter (2) from valve body.

(3) Push plunger (3) out of the adapter and remove preformed packing (4) from the plunger.

(4) Remove cap nut (5) from the inlet end of the body and remove spring (6).

(5) Push the valve stem (7) out of the body (10). Remove preformed packing (8) and valve (9) from the stem.



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- |                      |                      |
|----------------------|----------------------|
| 1. Mounting nut      | 6. Spring            |
| 2. Adapter           | 7. Valve stem        |
| 3. Plunger           | 8. Preformed packing |
| 4. Preformed packing | 9. Valve             |
| 5. Cap nut           | 10. Body             |

Figure 8-34. Clutch cutout control valve, exploded view.

**c. Cleaning, Inspection and Repair.**

(1) Clean all metal components with solvent. Wipe rubber parts with a dry cloth.

(2) Inspect spring for cracks, corrosion and distortion.

(3) Check valve stem for wear.

(4) Inspect adapter and valve body for cracks and other defects. Inspect bores for excessive wear.

**d. Reassembly.** Assemble valve by reversing the disassembly procedure. Lubricate plunger, valve stem, adapter and valve body bores, preformed packings and valve before assembly.

**e. Installation.**

(1) Position the control valve in the bracket and install retaining nut. Tighten finger-tight.

(2) Connect air lines to the valve.

(3) Tighten mounting nuts.

**f. Adjustment.**

(1) Place the shift lever in neutral position.

(2) Locate the actuator on the shift lever shaft until the ramp on the actuator arm is aligned to the valve poppet and will engage the ramp without interference. Refer to figure 8-35. Tighten setscrew.

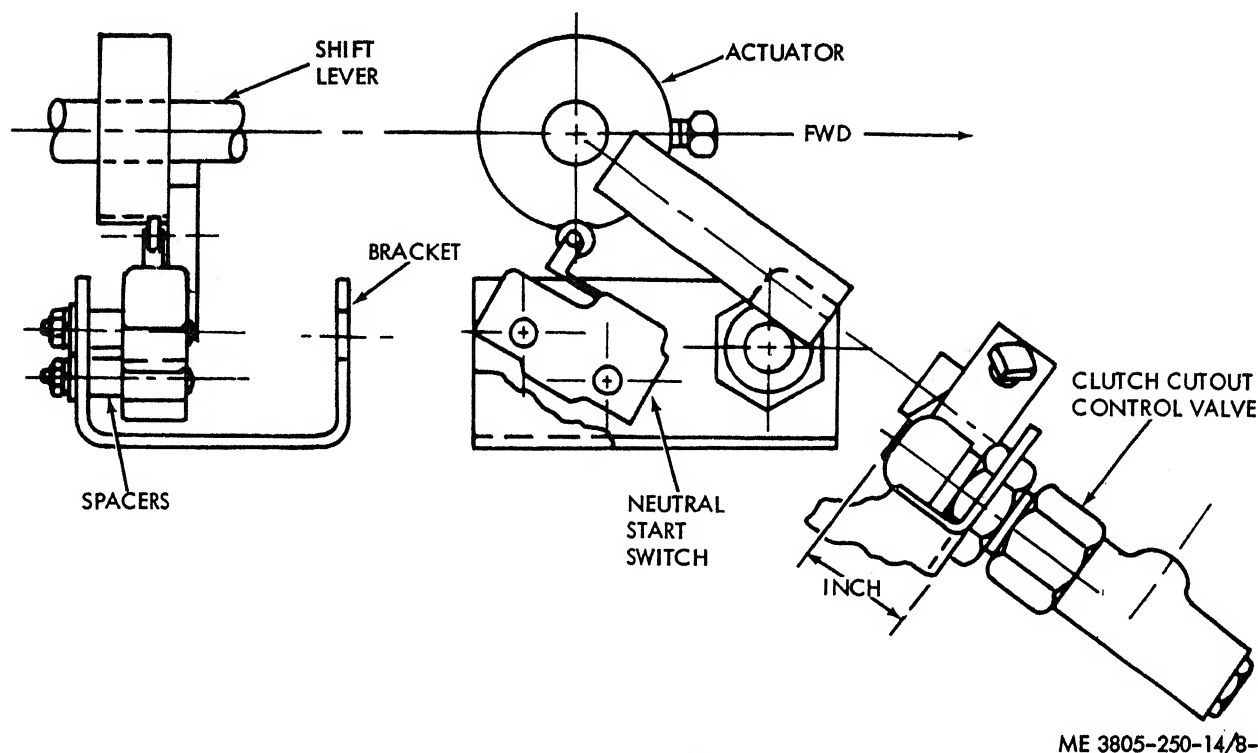


Figure 8-35. Clutch cutout adjustment.

(3) Move the neutral start switch until the contact roller engages the grooves in the collar. Ensure that the contacts in the switch remain closed.

*Note.* If proper adjustment cannot be obtained, move the mounting bracket and repeat steps (2) and (3).

(4) Check for proper adjustment as follows:

(a) Move the shift lever within the limits of free play in the neutral position. Ensure that the actuator ramp does not depress the valve poppet.

(b) Move the shift lever to the high forward position and check for free movement when the cam depresses the valve poppet.

(c) Replace the shift lever in each lever position and check that the neutral start switch is inoperative in any position other than neutral.

(d) Apply the parking brake. Place the lever in neutral and start the engine. Place the shift lever in the forward low range position. Depress the brake to check the cutout valve for proper clutch disengagement. The clutch pressure gage should indicate no pressure when the brake is applied, and engine speed should increase approximately 100 rpm. Release the brake. Clutch engagement should be felt and pressure should be indicated on the clutch pressure gage.

## CHAPTER 9

### REPAIR OF BODY

#### Section I. EARTH MOVING EQUIPMENT

##### 9-1. General

a. The earth moving equipment consists of the lift and tilt linkage, cross links, and bucket. The lift arms are connected to the front section frame and the lower part of the bucket. The tilt linkage extends to the top of the bucket. Pins and bearings at connection points allow the linkage to pivot through all positions required in loading operations.

b. The multi-purpose bucket enables the loader to be used as a bulldozer, scraper, clamshell, or conventional bucket.

##### 9-2. Loader Bucket Assembly

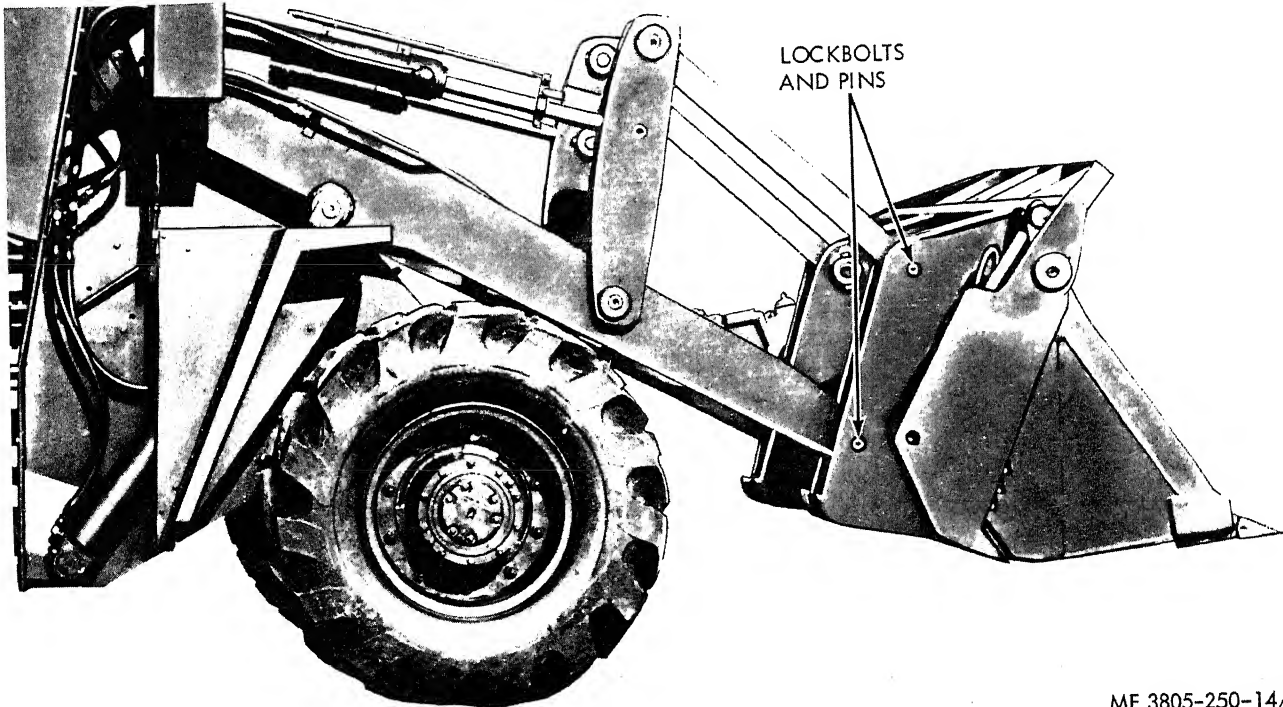
a. *Removal.* Refer to figure 9-1.

(1) Rest the bucket in a level position on blocks or supports.

(2) Disconnect bucket hoses. Cap or plug openings.

*Note.* Do not move the bucket control levers unless hose openings are securely plugged.

(3) Remove the lockbolts and pins securing the loader arm to the bucket link. Back the loader away from the bucket.



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Figure 9-1. Bucket, removal and installation.

b. *Disassembly.* Refer to figure 9-2.

(1) Remove the clam cylinders (para 8-13).

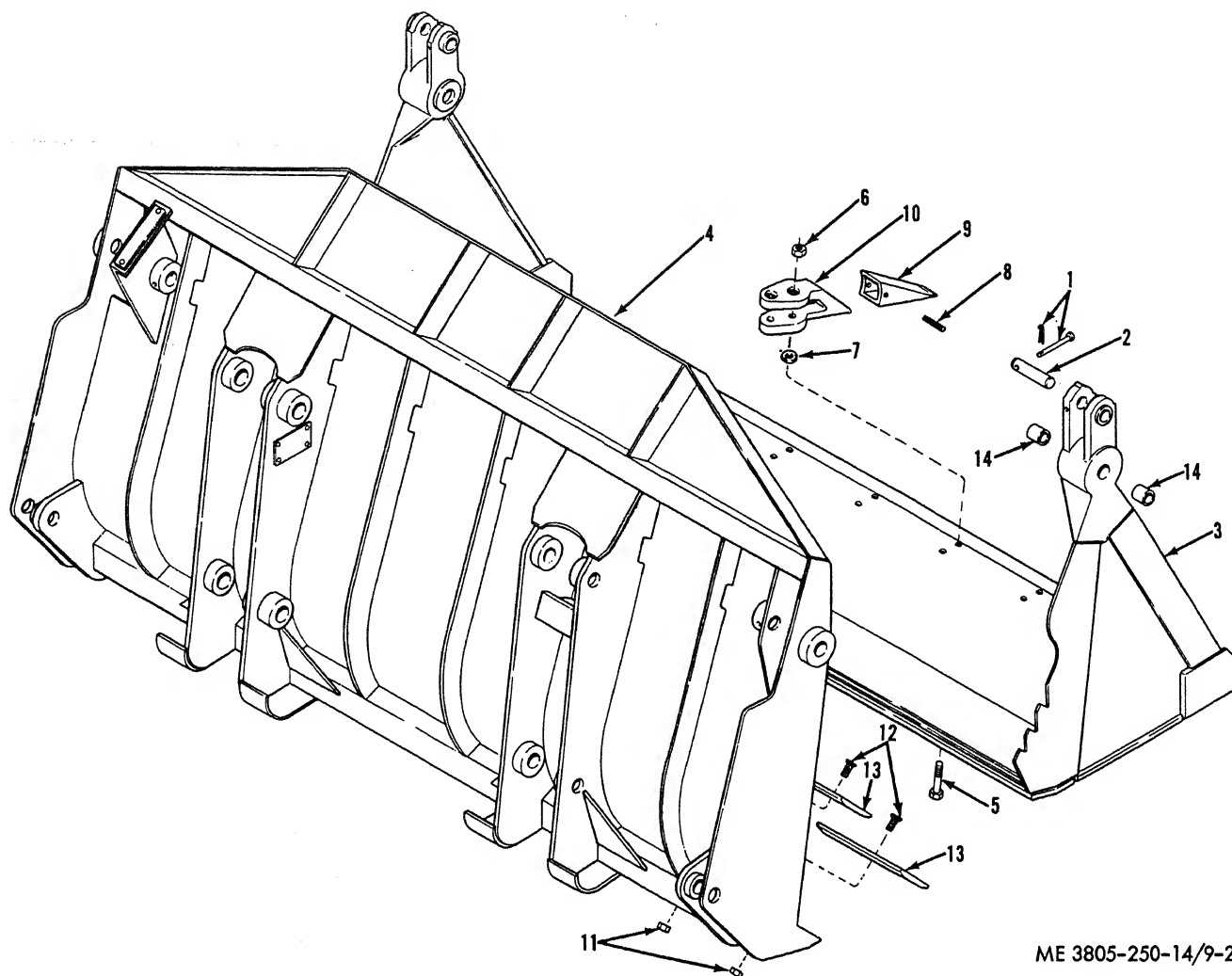
(2) Remove the cotter key and pin (1) and pin (2) securing each side of the clam (3) to the moldboard (4). Separate the sections.

(3) Remove the nine teeth from the clam by

removing two bolts (5), nuts (6) and washers (7) from each of the teeth. Remove the pins (8) securing teeth tips (9) to shanks (10).

(4) Remove nineteen nuts (11) and bolts (12) securing blade (13) to the moldboard.

(5) If necessary, remove bushings (14).



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1. Cotter key and pin
2. Pin
3. Clam
4. Moldboard
5. Bolt
6. Nut
7. Washer

8. Pin
9. Tip
10. Shank
11. Nut
12. Bolt
13. Blade
14. Bushing

Figure 9-2. Bucket, exploded view.

**c. Cleaning, Inspection and Repair.**

- (1) Clean bucket of dirt and grease.
- (2) Inspect bucket, blades and teeth for cracks. Repair bucket by welding.
- (3) Inspect retaining pins and bushings for wear. Replace as necessary.

**d. Reassembly.** Assemble bucket by reversing the disassembly procedure.

**e. Installation.** Install bucket by reversing the removal procedure.

**9-3. Tilt Linkage**

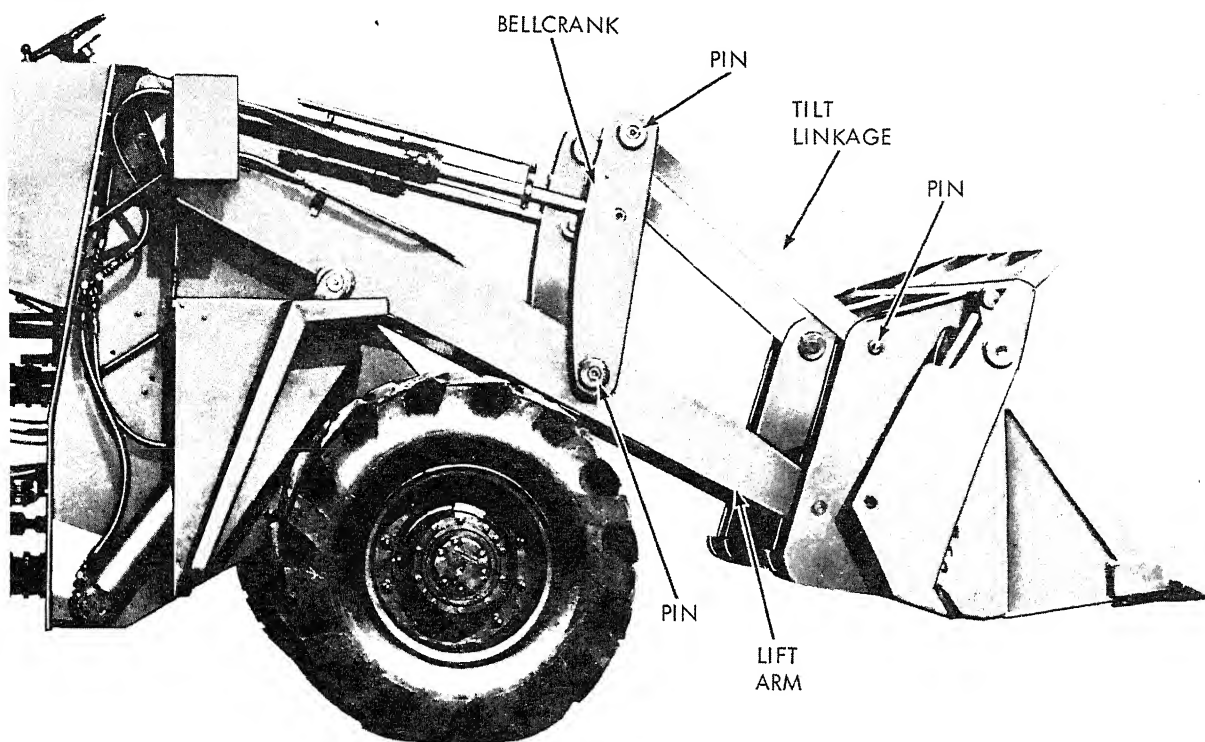
**a. Removal.** Refer to figure 9-3.

(1) Lower the bucket to the ground and remove the tilt cylinders (para 8-14).

(2) Remove bolt and nut securing the pin which connects the linkage to the bucket. Remove the pin.

(3) Remove bolt, nut and pin securing the link to the bellcrank and remove the link.

(4) Remove the bolt, nut and pin securing the bellcrank to the lift arm. Remove the bellcrank.



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Figure 9-3. Tilt linkage, removal and installation.

**b. Cleaning, Inspection and Repair.**

- (1) Remove accumulations of dirt and grease from the link and bellcrank.
- (2) Inspect bushings for wear and replace as necessary.
- (3) Inspect for damage to the bellcrank which would impair the operation of the tilt linkage.
- (4) Inspect pins for wear, flat spots or other damage. Replace as necessary.

**c. Installation.**

- (1) Install tilt linkage by reversing the removal procedure.
- (2) Lubricate at grease fittings.
- (3) Start the engine and operate the bucket through several complete cycles. Check for binding of the tilt linkage and for hydraulic leaks.

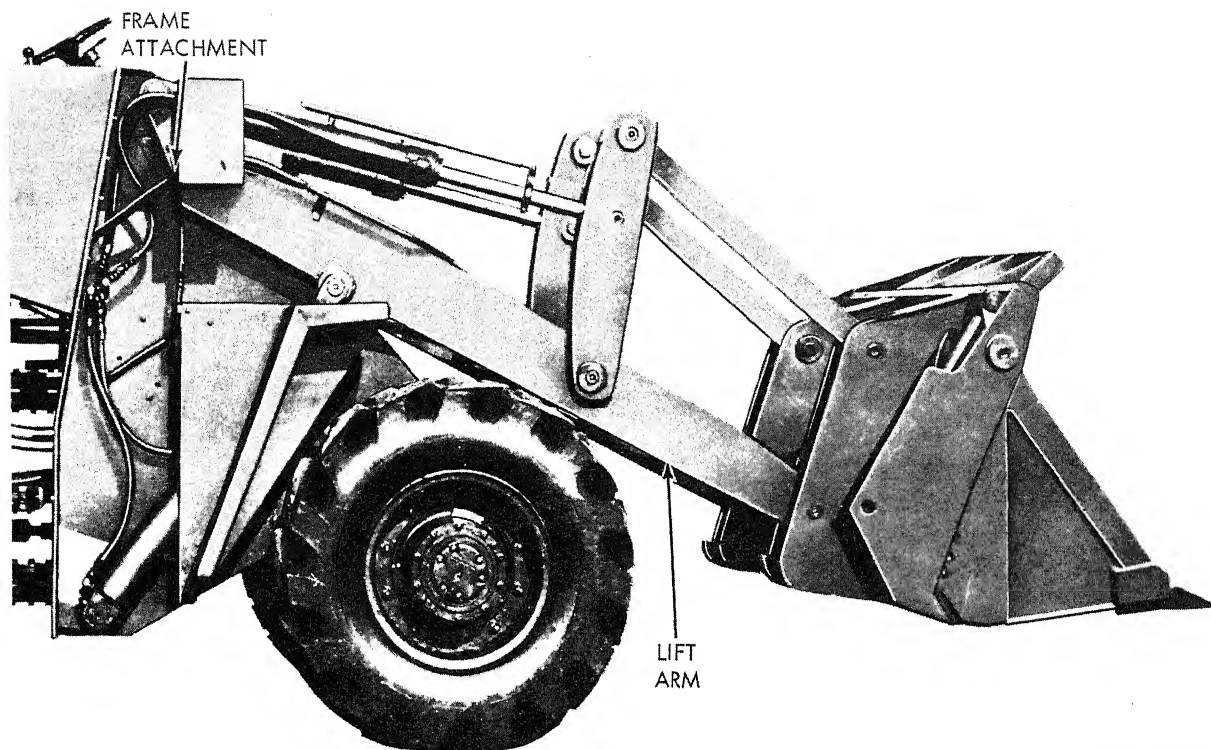
- (4) Check the hydraulic reservoir and add oil as necessary.

**9-4. Lift Arms**

**a. Removal.** Refer to figure 9-4.

- (1) Remove the bucket (para 9-2).
- (2) Remove the lift cylinders (para 8-14), return-to-dig linkage, and hydraulic lines and clamps.
- (3) Remove the tilt linkage (para 9-3).
- (4) Support the lift arm with a hoist and remove the retaining ring, washers, shims and pin securing each lift arm to the frame. Hoist the lift arm away from the loader body.





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Figure 9-4. Lift arms, removal and installation.

*b. Cleaning, Inspection and Repair.*

- (1) Inspect arm fittings for an accumulation of dirt or grease and clean with solvent.
- (2) Inspect bushings for wear and replace as necessary.
- (3) Replace retaining rings.
- (4) Inspect lift arm for damage which would impair operation.

*c. Installation.*

- (1) Install lift arms by reversing the removal

procedure. Install the same number of shims as were removed. Shims are used to eliminate play between the frame and chassis.

- (2) Lubricate the grease fittings.

(3) Start the engine and pressurize the hydraulic system. Operate the bucket through several complete cycles and check operation. Check for hydraulic leaks.

- (4) Check the oil level in the hydraulic reservoir and add oil as necessary.

## Section II. FRAME

### 9-5. General

The frame consists of the hood and fenders and front and rear structural components.

### 9-6. Repair

- a. Inspect the frame for cracked or broken

welds, distortion, and other damage. Weld cracks. Replace badly damaged frame.

- b. Inspect frame pivot spindles and thrust bearings for cracks, galling, scoring and wear.

- c. Check alignment of frame pivot bores.

- d. Inspect frame hardware and threaded holes for thread damage.

## APPENDIX A

### REFERENCES

---

#### A-1. Fire Protection

TB 5-4200-200-10

Hand Portable Fire Extinguishers for Army Users

#### A-2. Lubrication

LO 5-3805-250-12

C9100-IL

Department of the Army Lubrication Order  
Fuels, Lubricants, Oils and Waxes

#### A-3. Painting

TM 9-213

Painting Instructions for Field Use

#### A-4. Preventive Maintenance

TM 9-1870-1

TM 38-750

TB 750-651

TM 9-6140-200-15

Care and Maintenance of Pneumatic Tires  
Army Equipment Record Procedures  
Antifreeze  
Maintenance of Storage Batteries, Lead-Acid Type

#### A-5. Shipment and Storage

TM 38-230

TM 740-90-1

TM 740-93-3

Preservation, Packaging, and Packing of Military Supplies and  
Equipment  
Shipment and Storage  
Shipment and Storage

#### A-6. Destruction of Army Materiel

TM 750-244-3

Procedures for Destruction of Equipment to Prevent Enemy  
Use

## APPENDIX B

### MAINTENANCE ALLOCATION CHART

#### Section I. INTRODUCTION

##### B-1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes and / or illustrations required for a particular maintenance function.

##### B-2. Explanation of Columns in Section II

a. *Group Number, Column (1).* The assembly group is a numerical group assigned to each assembly in a top down breakdown sequence. The applicable assembly groups are listed on the MAC in disassembly sequence beginning with the first assembly removed in a top down disassembly sequence.

b. *Assembly Group, Column (2).* This column contains a brief description of the components of each assembly group.

c. *Maintenance Functions, Column (3).* This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

- C — Operator or crew
- O — Organizational maintenance
- F — Direct support maintenance
- H — General support maintenance
- D — Depot maintenance

The maintenance functions are defined as follows:

A — Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B — Test. To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C — Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

D — Adjust. To rectify to the extent necessary to bring into proper operating range.

E — Align. To adjust specified variable elements of an item to bring to optimum performance.

F — Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G — Install. To set up for use in an operational environment such as an emplacement, site, or vehicle.

H — Replace. To replace unserviceable items with serviceable like items.

I — Repair. Those maintenance operations necessary to restore an item to serviceable condition through correction of material damage or a specific failure. Repair may be accomplished at each category of maintenance.

J — Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

K — Rebuild. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

*d. Tools and Equipment, Column (4).* This column is provided for referencing by code the special tools and test equipment, (sec. III) required to perform the maintenance functions (sec. II).

*e. Remarks, Column (5).* This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance functions.

**B-3. Explanation of Columns in Section III  
(Not Applicable)**

**B-4. Explanation of Columns in Section IV**

*a..Reference Code.* This column consists of two letters separated by a dash, both of which are references to section II. The first letter references column (5) and the second letter references a maintenance function, column (3), A through K.

*b. Remarks.* This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, section II.

## Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Assembly group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
01	ENGINE ASSEMBLY:													
	Engine, Diesel .....	C	F	C					F	F	D	D		A
	Head, Cylinder .....								F	H	D	D		B
	Crankshaft .....	H							H	F	D	D		C
	Flywheel Assembly .....								F					
	Valves, Camshaft and Timing System:								H	H	D	D		D
	Valves & Inserts .....				F				F	F				
	Arm Assembly, Rocker .....			O					O					
	Filter Assembly Oil .....			O					O					
	Breather, Crankcase .....			O										
02	FUEL SYSTEM:													
	Fuel Injector Assembly .....		F						F		D	D		
	Fuel Pump .....			C					O	F	D	D		
	Air Cleaner .....								O	H	D	D		
	Turbocharger .....			C					O	F				
	Tank, Lines & Fittings .....			C					O					
	Fuel Filters .....													
03	EXHAUST SYSTEM:													
	Pipes & Clamps .....	O							O					
04	COOLING SYSTEM:													
	Radiator .....		O	C					F	F				
	Water Pump .....								O	O				
	Fan Assembly .....	C			O				O					
	Belts .....													
05	ELECTRICAL SYSTEM:													
	Alternator .....			O					O	F	D	D		
	Belts .....	C			O				O					
	Regulator, Alternator .....			O					O	F	D	D		
	Starting, Motor .....			O					O					
	Batteries, Storage .....													
06	TRANSMISSION:													
	Transmission Assembly .....			O					F	F	D	D		
	Valve, Control .....								F	F	D	D		
	Pumps .....								F	F	D	D		
	Filter Oil .....								O					
07	PROPELLER SHAFTS:													
	Propeller Shafts .....								F	F				
08	FRONT AXLE:													
	Front Axle Assembly .....	C		O					F	F	D	D		
	Differential .....			O					H	H	D	D		
	Planetary Drive .....			O					F	F	D	D		

# Section II. MAINTENANCE ALLOCATION CHART—Continued

(1) Group No.	(2) Assembly group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
09	REAR AXLE ASSEMBLY:													
	Rear Axle Assembly .....	C	..	O	..	..	..	..	F	F	D	D		
	Differential .....	..	..	O	..	..	..	..	H	H	D	D		
	Planetary Drive .....	..	..	O	..	..	..	..	F	F	D	D		
10	BRAKES:													
	Hand Brake .....	..	..	..	O	..	..	..	F	F	..	..		
	Service Brake .....	..	..	..	O	..	..	..	F	F	..	..		
	Hydraulic Brake System:													
	Hydraulic Master Cylinder .....	O	..	O	..	..	..	..	F	F	..	..		
	Brake Hose, Lines .....	O	..	..	..	..	..	..	F	F	..	..		
11	WHEELS:													
	Tires & Rims .....	C	C	C	..	..	..	..	O	O	..	..		
12	STEERING:													
	Steering Assembly .....	C	..	O	..	..	..	..	F	H	D	D		
	Hoses, Lines & Fittings .....	C	..	..	..	..	..	..	O	O	..	..		
	Hydraulic, Cylinder .....	C	..	..	..	..	..	..	F	F	D	D		
	Valve, Steering .....	C	..	..	..	..	..	..	F	F	D	D		
13	HOOD:													
	Seat .....	..	..	..	C	..	..	..	O	O	..	..		
14	HYDRAULIC LIFT COMPONENT:													
	Hydraulic Pump .....	..	F	..	..	..	..	..	F	F	D	D		
	Control Valves .....	..	F	..	..	..	..	F	F	D	D	..		
	Control Levers & Linkages .....	C	..	..	O	..	..	..	O	..	..	..		
	Hydraulic Cylinders:													
	Boom, Bucket, Clam .....	C	..	..	..	..	..	..	F	F	D	D		
	Hydraulic Lines & Fittings .....	C	..	..	..	..	..	..	O	O	..	..		
	Tank .....	C	..	C	..	..	..	..	O	O	..	..		
	Filters .....	..	..	O	..	..	..	..	O	O	..	..		
15	PNEUMATIC EQUIPMENT:													
	Air Compressor:													
	Crankcase, Block .....	..	..	..	..	..	..	..	H	H	D	D		
	Cylinder Head .....	..	..	..	..	..	..	..	F	H	D	D		
	Piston, Connecting Rods .....	..	..	..	..	..	..	..	H	H	D	D		
	Compressor Drives .....	..	..	..	..	..	..	..	F	F	..	..		
	Air Governor .....	O	..	..	O	..	..	..	O	..	..	..		
16	EARTH MOVING EQUIPMENT:													
	Lift Arms, Bar, Boom Carrier .....	..	..	O	..	..	..	..	F	F	..	..		
	Shafts, Pins, Latches .....	..	..	O	O	..	..	..	O	O	..	..		
	FIRE FIGHTING EQUIPMENT AND COMPONENTS:													
	Fire Extinguisher & Brackets .....	C	..	O	..	..	..	..	O	O	..	..		

#### Section IV. EXPLANATORY NOTES AND SUPPLEMENTAL INSTRUCTIONS

Reference Code	Remarks
A — B	Test includes engine operation and compression.
B — K	Rebuild includes align, metalize and resize.
C — H	Replace ring gear.
D — H	Reface.
E — C	Service includes draining water.

# APPENDIX C

## BASIC ISSUE ITEMS LIST

### Section I. INTRODUCTION

#### 1. Scope

This appendix lists items which accompany the MW24 Scoop Loader or are required for installation, operation, or operator's maintenance.

#### 2. General

This Basic Issue Items List is divided into the following sections:

- a. *Basic Issue Items Section (II)*. A list of items which accompany the MW24 Scoop Loader and are required by the operator / crew for installation, operation, or maintenance.
- b. *Maintenance and Operating Supplies Section (I)*. A listing of maintenance and operating supplies required for initial operation.

#### 3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items, section II.

##### a. *Source, Maintenance, and Recoverability Codes (SMR), Column (1)*.

(1) Source code indicates the selection status of source for the listed item. Source codes are:

Code	Explanation
P	Repair parts which are stocked in or supplied from the GAS / DSA, or Army supply system and authorized for use at indicated maintenance categories.
P2	Repair parts which are procured and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.
M	Repair parts which are not procured or stocked, but are to be manufactured in indicated maintenance levels.
A	Assemblies which are not procured or stocked as such, but are made up of two or more units. Such component units carry individual stock numbers and descriptions, are procured and stocked separately and can be assembled to form the required assembly at indicated maintenance categories.
X	Parts and assemblies which are not procured or stocked and the mortality of which normally is below that of the applicable end item or component. The failure of such part or assembly should result in retirement of the end item from the supply system.
X1	Repair parts which are not procured or stocked. The requirement of such items will be filled by use of the next higher assembly or component.

#### Code

#### Explanation

X2	Repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization. Where such repair parts are not obtainable through cannibalization, requirements will be requisitioned, with accompanying justification, through normal supply channels.
G	Major assemblies that are procured with PEMA funds for initial issue only as exchange assemblies at DSU and GSU level. These assemblies will not be stocked above GS and DS level or returned to depot supply level.

(2) Maintenance code indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

#### Code

#### Explanation

C	Operator / crew
---	-----------------

(3) Recoverability code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable. Recoverability codes are:

#### Code

#### Explanation

R	Repair parts (assemblies and components) which are considered economically repairable at direct and general support maintenance levels. When the maintenance capability to repair these items does not exist, they are normally disposed of at the GS level. When supply considerations dictate, some of these repair parts may be listed for automatic return to supply for depot level repair as set forth in AR 710-50. When so listed, they will be replaced by supply on an exchange basis.
S	Repair parts and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis. When items are determined by a GSU to be uneconomically repairable they will be evacuated to a depot for evaluation and analysis before final disposition.
T	High dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance activities.
U	Repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, or high dollar value reusable casings or castings.



*b. Federal Stock Number.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description.* This column indicates the Federal item name and any additional description of the item required. The abbreviation "w/e", when used as a part of the nomenclature, indicates the Federal stock number, includes all armament, equipment, accessories, and repair parts issued with the item. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parenthesis. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

*d. Unit of Measure (U/M).* A two-character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

*e. Quantity Incorporated in Unit.* This column indicates the quantity of the item used in the assembly group. A "V" appearing in this column in lieu of a quantity indicates that a definite quantity cannot be indicated (e.g. shims, spacers, etc.)

*f. Quantity Furnished With Equipment.* This column indicates the quantity of an item furnished with the equipment.

*g. Illustration.* This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item number.* Indicates the callout number used to reference the item in the illustration.

#### **C-4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies — Section III**

*a. Component Application.* This column identifies the component application of each maintenance or operating supply item.

*b. Federal Stock Number.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description.* This column indicates the item name and brief description.

*d. Quantity Required for Initial Operation.* This column indicates the quantity of each maintenance or operating supply item required for initial Operation of the equipment.

*e. Quantity Required for 8 Hours Operation.* This column indicates the estimated quantities required for an average 8 hours of operation.

*f. Notes.* This column indicates informative notes keyed to data appearing in a preceding column.

## Section II. BASIC ISSUE ITEMS LIST

(1) Source, maint, and recov code			(2)  Federal stock number	(3)  Description	(4)  Unit of issue	(5)  Qty inc in unit	(6)  Qty furn with equip	(7) Illustration	
(A) S	(B) M	(C) R						(A) Fig. No.	(B) Item No.
P	C		7510-889-3894	Binder, Loose Leaf: US Army Equipment Log	EA	1	1		
P	C		7520-559-9618	Case, Operation and Maintenance Manuals: Cotton Duck, Water Repellant, Mildew resistant, MIL-B-11734B	EA	1	1		
P	C		4210-889-2221	Extinguisher, Fire; Dry, Hand Type, 2½ lb. Fed. Spec. O-E-95, Type III, Class 2, Walter Kidde, P / N 874195 or Equal.	EA	1	1		
				Manual: TM 5-3805-250-14	EA	1	1		
				Department of the Army Lubrication Order, LO 5-3805-25-12	EA	1	1		

## Section III. MAINTENANCE AND OPERATING SUPPLIES

(1) Component application	(2) Federal stock number	(3) Description	(4) Quantity required F / Initial operation	(5) Quantity required F / 8 hrs operation	(6) Notes
CRANKCASE	..... 9150-680-1099(2) 9150-680-1102(2)	OIL, LUBRICATING, ENGINE: 5-gal can as follows: HDO-30 HDO-10	19 qts 19 qts	(3) (3)	(1) Includes quantity of oil to fill engine oil system as follows: 17 qt — crankcase 2 qt — oil filter
DIFFERENTIAL FRONT AND REAR	9150-242-7603(2) ..... 9150-577-5844(2) 9150-257-5440(2)	OES  LUBRICATING OIL, GEAR: 5-gal pail as follows: GO-90 GOS	19 qts  13 qts ea 13 qts ea	(3)  (3) (3)	(2) See C9100-IL for additional data and requisitioning procedure. (3) See current LO for grade, application and replenishment intervals.
FUEL TANK	..... 9140-286-5294(2) 9140-286-5286(2) 9140-286-5283(2)	FUEL, DIESEL: Bulk as follows: DF-2 DF-1 DF-A	74 gal (4) 74 gal (4) 74 gal (4)	(5) (5) (5)	(4) Tank capacity. (5) Average fuel consumption 3.95 gal per hr of continuous operation.
GREASE POINTS	..... 9150-190-0905(2) ..... 9150-231-9071(2)	GEASE, AUTOMOTIVE AND ARTILLERY: 5-lb can as follows: GAA  BRAKE FLUID, AUTOMOTIVE: 1-gal can as follows: HBA	5 lb  1 pte	(3)	(6) Use oil as prescribed for differential. (7) Use oil as prescribed for oil can points.
HYDRAULIC BRAKES	..... 9150-265-9429(2) 9150-242-7604(2)	OIL, LUBRICATING, ENGINE: 55-gal drum as follows: OE-10 OES	83 qts 83 qts	(3) (3)	(8) Use oil as prescribed for hydraulic reservoir.
HYDRAULIC RESERVOIR	..... 9150-265-9435(2) 9150-265-9428(2) 9150-242-7603(2)	OIL, LUBRICATING, ENGINE: 5-gal can as follows: OE-30 OE-10 OES	As req As req As req	(3) (3) (3)	
OIL CAN POINTS	..... 9150-265-9435(2) 9150-265-9428(2) 9150-242-7603(2)	LUBRICATING OIL, GEAR (6) GO-90 GOS	6½ qts ea 6½ qts ea	(3) (3)	
PLANETARY	..... ..... .....	WATER ANTIFREEZE: 55-gal drum as follows:  ANTIFREEZE: Ethylene Glycol	48 qts 28 qts		
RADIATOR	6850-644-1409				

### Section III. MAINTENANCE AND OPERATING SUPPLIES

(1) Component application	(2) Federal stock number	(3) Description	(4) Quantity required F / initial operation	(5) Quantity required F / 8 hrs operation	(6) Notes
STEERING GEAR	6850-174-1806	ANTIFREEZE: Compound Arctic	48 qts		
	.....	OIL, LUBRICATING, ENGINE (7) OE-30 OE-10 OES	1½ qts 1½ qts 1½ qts	(3) (3) (3)	
	.....	OIL, LUBRICATING, ENGINE (8) OE-10 OES	40 qts 40 qts		
TRANSMISSION AND CONVERTER					

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